YAMAHA

YAMAHA SCARA ROBOT

YK-XG Series

Installation Manual

Clean room models
YK250XGC / YK350XGC / YK400XGC / YK500XGLC / YK600XGLC

Dust/drip proof models
YK250XGP / YK350XGP / YK400XGP / YK500XGLP / YK600XGLP

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1. Safety Information

Industrial robots are highly programmable, mechanical devices that provide a large degree of freedom when performing various manipulative tasks. To ensure safe and correct use of YAMAHA industrial robots and controllers, carefully read and comply with the safety instructions and precautions in this "Safety Instructions" guide. Failure to take necessary safety measures or incorrect handling may result in trouble or damage to the robot and controller, and also may cause personal injury (to installation personnel, robot operator or service personnel) including fatal accidents.

Before using this product, read this manual and related manuals and take safety precautions to ensure correct handling.
The precautions listed in this manual relate to this product. To ensure safety of the user's final system that includes YAMAHA robots, please take appropriate safety measures as required by the user's individual system.

To use YAMAHA robots and controllers safely and correctly, always comply with the safety rules and instructions.

- For specific safety information and standards, refer to the applicable local regulations and comply with the instructions.
- This manual and warning labels supplied with or attached to the robot are written in English. Unless the robot operators or service personnel understand English, do not permit them to handle the robot.
- Cautions regarding the official language of EU countries
  For equipment that will be installed in EU countries, the language used for the manuals, warning labels, operation screen characters, and CE declarations is English only.
  Warning labels only have pictograms or else include warning messages in English. In the latter case, messages in Japanese or other languages might be added.

It is not possible to list all safety items in detail within the limited space of this manual. So please note that it is essential that the user have a full knowledge of safety and also make correct judgments on safety procedures.

Refer to the manual by any of the following methods when installing, operating or adjusting the robot and controller.

1. Install, operate or adjust the robot and controller while referring to the printed version of the manual (available for an additional fee).
2. Install, operate or adjust the robot and controller while viewing the CD-ROM version of the manual on your computer screen.
3. Install, operate or adjust the robot and controller while referring to a printout of the necessary pages from the CD-ROM version of the manual.

2. Signal words used in this manual

This manual uses the following safety alert symbols and signal words to provide safety instructions that must be observed and to describe handling precautions, prohibited actions, and compulsory actions. Make sure you understand the meaning of each symbol and signal word and then read this manual.

⚠ DANGER

THIS INDICATES AN IMMEDIATELY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.

⚠ WARNING

THIS INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY.

⚠ CAUTION

This indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury, or damage to the equipment.

NOTE

Explains the key point in the operation in a simple and clear manner.

3. Warning labels

Warning labels shown below are attached to the robot body and controller to alert the operator to potential hazards. To ensure correct use, read the warning labels and comply with the instructions.

3.1 Warning labels

⚠WARNING

IF WARNING LABELS ARE REMOVED OR DIFFICULT TO SEE, THEN THE NECESSARY PRECAUTIONS MAY NOT BE TAKEN, RESULTING IN AN ACIDENT.

- DO NOT REMOVE, ALTER OR STAIN THE WARNING LABELS ON THE ROBOT BODY.
- DO NOT ALLOW WARNING LABELS TO BE HIDDEN BY DEVICES INSTALLED ON THE ROBOT BY THE USER.
- PROVIDE PROPER LIGHTING SO THAT THE SYMBOLS AND INSTRUCTIONS ON THE WARNING LABELS CAN BE CLEARLY SEEN FROM OUTSIDE THE SAFETY ENCLOSURE.

3.1.1 Warning label messages

Word messages on the danger, warning and caution labels are concise and brief instructions. For more specific instructions, read and follow the "Instructions on this label" described on the right of each label shown below.

1. Warning label 1 (SCARA robots, Cartesian robots)

⚠DANGER

SERIOUS INJURY MAY RESULT FROM CONTACT WITH A MOVING ROBOT.

- KEEP OUTSIDE OF THE ROBOT SAFETY ENCLOSURE DURING OPERATION.
- PRESS THE EMERGENCY STOP BUTTON BEFORE ENTERING THE SAFETY ENCLOSURE.

Instructions on this label
• Always install a safety enclosure to keep all persons away from the robot movement range and prevent injury from contacting the moving part of the robot. • Install an interlock that triggers emergency stop when the door or gate of the safety enclosure is opened. • The safety enclosure should be designed so that no one can enter inside except from the door or gate equipped with an interlock device. • Warning label 1 that comes supplied with a robot should be affixed to an easy-to-see location on the door or gate of the safety enclosure.

90K41-001470

2. Warning label 2 (SCARA robots, Cartesian robots, single-axis robots*)

* Warning label 2 is not attached to some small single-axis robots, but is supplied with the robots.

⚠WARNING

MOVING PARTS CAN PINCH OR CRUSH HANDS.
KEEP HANDS AWAY FROM THE MOVABLE PARTS OF THE ROBOT.

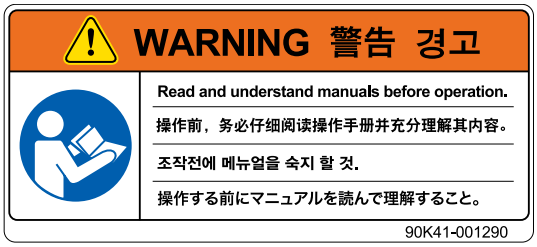
Instructions on this label
Use caution to prevent hands and fingers from being pinched or crushed by the movable parts of the robot when transporting or moving the robot or during teaching.

90K41-001460

3. Warning label 3 (SCARA robots, Cartesian robots)

⚠WARNING

IMPROPER INSTALLATION OR OPERATION MAY CAUSE SERIOUS INJURY.
BEFORE INSTALLING OR OPERATING THE ROBOT, READ THE MANUAL AND INSTRUCTIONS ON THE WARNING LABELS AND UNDERSTAND THE CONTENTS.



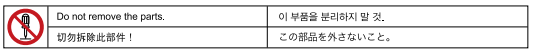
Instructions on this label
• Be sure to read the warning label and this manual carefully to make you completely understand the contents before attempting installation and operation of the robot. • Before starting the robot operation, even after you have read through this manual, read again the corresponding procedures and "Safety instructions" in this manual. • Never install, adjust, inspect or service the robot in any manner that does not comply with the instructions in this manual.

90K41-001290

4. Warning label 4 (SCARA robots)

⚠CAUTION

Do not remove the parts on which Warning label 4 is attached.
Doing so may damage the ball screw.



Instructions on this label
The Z-axis ball screw will be damaged if the upper end mechanical stopper on the Z-axis spline is removed or moved. Never attempt to remove or move it.

90K41-001520

5. "Read instruction manual" label (Controller)*

⚠CAUTION

Refer to the manual.

Instructions on this label
This indicates important information that you must know and is described in the manual. Before using the controller, be sure to read the manual thoroughly. When adding external safety circuits or connecting a power supply to the controller, read the manual carefully and make checks before beginning the work. Connectors must be attached while facing a certain direction, so insert each connector in the correct direction.

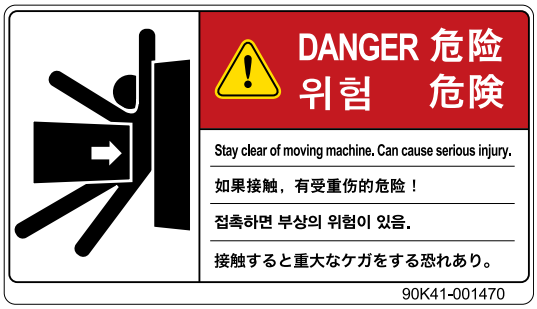
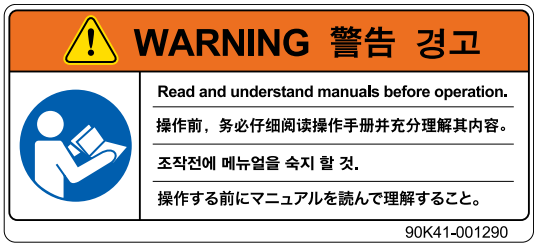
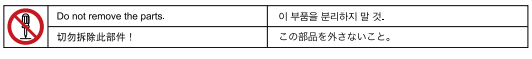
93005-X0-00

* This label is attached near the power input connector on the front panel.

3.1.2 Supplied warning labels

Some warning labels are not affixed to robots but included in the packing box. **These warning labels should be affixed to an easy-to-see location.**

● Warning label is attached to the robot body.
○ Warning label comes supplied with the robot and should be affixed to an easy-to-see location on the door or gate of the safety enclosure.
◎ Warning label comes supplied with the robot and should be affixed to an easy-to-see location.

		SCARA robots	Cartesian robots	Single-axis robots
Warning label 1		●*1 ○	● ○	 ○
Warning label 2		●*1	●	●*2
Warning label 3		●*1	●	◎
Warning label 4		●*1		

*1: For the label positions, see the SCARA robot user's manual ("1.2 Part names" in Chapter 1).
*2: This label is not attached to some small single-axis robots, but is supplied with the robots.

3.2 Warning symbols

Warning symbols shown below are printed on the robot and controller to alert the operator to potential hazards. To use the YAMAHA robot safely and correctly always follow the instructions and cautions indicated by the symbols.

1. Electrical shock hazard symbol

⚠WARNING

TOUCHING THE TERMINAL BLOCK OR CONNECTOR MAY CAUSE ELECTRICAL SHOCK, SO USE CAUTION.

	Instructions by this symbol
	This indicates a high voltage is present. Touching the terminal block or connector may cause electrical shock.

93006-X0-00

2. High temperature hazard symbol

⚠WARNING

MOTORS, HEATSINKS, AND REGENERATIVE UNITS BECOME HOT, SO DO NOT TOUCH THEM.

	Instructions by this symbol
	This indicates the area around this symbol may become very hot. Motors, heatsinks, and regenerative units become hot during and shortly after operation. To avoid burns be careful not to touch those sections.

93008-X0-00

3. Caution symbol

⚠CAUTION

Always read the manual carefully before using the controller.

	Instructions by this symbol
	This indicates important information that you must know and is described in the manual. Before using the controller, be sure to read the manual thoroughly. When adding external safety circuits or connecting a power supply to the controller, read the manual carefully and make checks before beginning the work. Connectors must be attached while facing a certain direction, so insert each connector in the correct direction.

93007-X0-00

4. Major precautions for each stage of use

This section describes major precautions that must be observed when using robots and controllers. Be sure to carefully read and comply with all of these precautions even if there is no alert symbol shown.

4.1 Precautions for using robots and controllers

General precautions for using robots and controllers are described below.

1. Applications where robots cannot be used

YAMAHA robots and robot controllers are designed as general-purpose industrial equipment and cannot be used for the following applications.

⚠DANGER

YAMAHA ROBOT CONTROLLERS AND ROBOTS ARE DESIGNED AS GENERAL-PURPOSE INDUSTRIAL EQUIPMENT AND CANNOT BE USED FOR THE FOLLOWING APPLICATIONS.

- **IN MEDICAL EQUIPMENT SYSTEMS WHICH ARE CRITICAL TO HUMAN LIFE**
- **IN SYSTEMS THAT SIGNIFICANTLY AFFECT SOCIETY AND THE GENERAL PUBLIC**
- **IN EQUIPMENT INTENDED TO CARRY OR TRANSPORT PEOPLE**
- **IN ENVIRONMENTS WHICH ARE SUBJECT TO VIBRATION SUCH AS ONBOARD SHIPS AND VEHICLES.**

2. Qualification of operators/workers

Operators or persons who handle the robot such as for teaching, programming, movement check, inspection, adjustment, and repair must receive appropriate training and also have the skills needed to perform the job correctly and safely. They must read the manual carefully to understand its contents before attempting the robot operation or maintenance.

Tasks related to industrial robots (teaching, programming, movement check, inspection, adjustment, repair, etc.) must be performed by qualified persons who meet requirements established by local regulations and standards for industrial robots.

⚠WARNING

- **THE ROBOT MUST BE OPERATED ONLY BY PERSONS WHO HAVE RECEIVED SAFETY AND OPERATION TRAINING. OPERATION BY AN UNTRAINED PERSON IS EXTREMELY HAZARDOUS.**
- **ADJUSTMENT AND MAINTENANCE BY REMOVING A COVER REQUIRE SPECIALIZED TECHNICAL KNOWLEDGE AND SKILLS, AND MAY ALSO INVOLVE HAZARDS IF ATTEMPTED BY AN UNSKILLED PERSON. THESE TASKS MUST BE PERFORMED ONLY BY PERSONS WHO HAVE ENOUGH ABILITY AND QUALIFICATIONS IN ACCORDANCE WITH LOCAL LAWS AND REGULATIONS. FOR DETAILED INFORMATION, PLEASE CONTACT YOUR DISTRIBUTOR WHERE YOU PURCHASED THE PRODUCT.**

4.2 Design

4.2.1 Precautions for robots

1. Provide safety measures for end effector (gripper, etc.)

⚠WARNING

- END EFFECTORS MUST BE DESIGNED AND MANUFACTURED SO THAT THEY CAUSE NO HAZARDS (SUCH AS A LOOSE WORKPIECE OR LOAD) EVEN IF POWER (ELECTRICITY, AIR PRESSURE, ETC.) IS SHUT OFF OR POWER FLUCTUATIONS OCCUR.
- IF THE OBJECT GRIPPED BY THE END EFFECTOR MIGHT POSSIBLY FLY OFF OR DROP, THEN PROVIDE APPROPRIATE SAFETY PROTECTION TAKING INTO ACCOUNT THE OBJECT SIZE, WEIGHT, TEMPERATURE, AND CHEMICAL PROPERTIES.

2. Provide adequate lighting

Provide enough lighting to ensure safety during work.

3. Install an operation status light

⚠WARNING

INSTALL A SIGNAL LIGHT (SIGNAL TOWER) AT AN EASY-TO-SEE POSITION SO THAT THE OPERATOR WILL BE AWARE OF THE ROBOT STOP STATUS (TEMPORARILY STOPPED, EMERGENCY STOP, ERROR STOP, ETC.).

4. Do not use robots for tasks requiring motor thrust

⚠CAUTION

Avoid using the belt-driven robots for tasks which make use of motor thrust (press-fitting, burr removal, etc.). These tasks may cause the robot to malfunction.

5. Clean work tools

Work tools such as welding guns and paint nozzles mounted on the robot manipulator tip should preferably be cleaned automatically when needed.

4.2.2 Precautions for robot controllers

1. Emergency stop input terminal

⚠DANGER

EACH ROBOT CONTROLLER HAS AN EMERGENCY STOP INPUT TERMINAL TO TRIGGER EMERGENCY STOP. USING THIS TERMINAL, INSTALL A SAFETY CIRCUIT SO THAT THE SYSTEM INCLUDING THE ROBOT CONTROLLER WILL WORK SAFELY.

2. Maintain clearance

⚠CAUTION

Do not bundle control lines or communication cables together or in close to the main power supply or power lines. Usually separate these by at least 100mm. Failure to follow this instruction may cause malfunction due to noise.

4.3 Moving and installation

4.3.1 Precautions for robots

■ Installation environment

1. Do not use in strong magnetic fields

⚠WARNING

DO NOT USE THE ROBOT NEAR EQUIPMENT OR IN LOCATIONS THAT GENERATE STRONG MAGNETIC FIELDS. THE ROBOT MAY BREAKDOWN OR MALFUNCTION IF USED IN SUCH LOCATIONS.

2. Do not use in locations subject to possible electromagnetic interference, etc.

⚠WARNING

DO NOT USE THE ROBOT IN LOCATIONS SUBJECT TO ELECTROMAGNETIC INTERFERENCE, ELECTROSTATIC DISCHARGE OR RADIO FREQUENCY INTERFERENCE. THE ROBOT MAY MALFUNCTION IF USED IN SUCH LOCATIONS CREATING HAZARDOUS SITUATIONS.

3. Do not use in locations exposed to flammable gases

⚠WARNING

- YAMAHA ROBOTS ARE NOT DESIGNED TO BE EXPLOSION-PROOF.
- DO NOT USE THE ROBOTS IN LOCATIONS EXPOSED TO EXPLOSIVE OR INFLAMMABLE GASES, DUST PARTICLES OR LIQUID. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH, OR LEAD TO FIRE.

■ Moving

1. Use caution to prevent pinching or crushing of hands or fingers

⚠WARNING

MOVING PARTS CAN PINCH OR CRUSH HANDS OR FINGERS.
KEEP HANDS AWAY FROM THE MOVABLE PARTS OF THE ROBOT.

As instructed in Warning label 2, use caution to prevent hands or fingers from being pinched or crushed by movable parts when transporting or moving the robot. For details on warning labels, see "3. Warning labels" in "Safety instructions."

2. Take safety measures when moving the robot

To ensure safety when moving a SCARA robot with an arm length of 500mm or more, use the eyebolts that come supplied with the robot.
Refer to the robot manual for details.

■ Installation

1. Protect electrical wiring and hydraulic/pneumatic hoses

Install a cover or similar item to protect the electrical wiring and hydraulic/pneumatic hoses from possible damage.

■ Wiring

1. Protective measures against electrical shock

⚠WARNING

ALWAYS GROUND THE ROBOT TO PREVENT ELECTRICAL SHOCK.

■ Adjustment

1. Adjustment that requires removing a cover

⚠WARNING

YAMAHA ROBOT CONTROLLERS ARE NOT DESIGNED TO BE EXPLOSION-PROOF. DO NOT USE THEM IN LOCATIONS EXPOSED TO EXPLOSIVE OR INFLAMMABLE GASES, GASOLINE OR SOLVENT. FAI LURE TO FOLLOW THIS INSTRUCTION MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH, OR LEAD TO FIRE. FOR DETAILED INFORMATION, PLEASE CONTACT YOUR DISTRIBUTOR WHERE YOU PURCHASED THE PRODUCT.

4.3.2 Precautions for robot controllers

■ Installation environment

1. Installation environment

⚠WARNING

YAMAHA ROBOTS AND ROBOT CONTROLLERS ARE NOT DESIGNED TO BE EXPLOSION-PROOF. DO NOT USE THEM IN LOCATIONS EXPOSED TO EXPLOSIVE OR INFLAMMABLE GASES, GASOLINE OR SOLVENT. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH, AND LEAD TO FIRE.

⚠WARNING

- USE THE ROBOT CONTROLLER IN LOCATIONS THAT SUPPORT THE ENVIRONMENTAL CONDITIONS SPECIFIED IN THIS MANUAL. OPERATION OUTSIDE THE SPECIFIED ENVIRONMENTAL RANGE MAY CAUSE ELECTRICAL SHOCK, FIRE, MALFUNCTION OR PRODUCT DAMAGE OR DETERIORATION.
- THE ROBOT CONTROLLER AND PROGRAMMING BOX SHOULD BE INSTALLED AT A LOCATION THAT IS OUTSIDE THE ROBOT MOVEMENT RANGE YET WHERE IT IS EASY TO OPERATE AND VIEW ROBOT MOVEMENT.
- INSTALL THE ROBOT CONTROLLER IN LOCATIONS WITH ENOUGH SPACE TO PERFORM WORK (TEACHING, INSPECTION, ETC.) SAFELY. LIMITED SPACE NOT ONLY MAKES IT DIFFICULT TO PERFORM WORK BUT CAN ALSO CAUSE INJURY.
- INSTALL THE ROBOT CONTROLLER IN A STABLE, LEVEL LOCATION AND SECURE IT FIRMLY. AVOID INSTALLING THE CONTROLLER UPSIDE DOWN OR IN A TILTED POSITION.
- PROVIDE SUFFICIENT CLEARANCE AROUND THE ROBOT CONTROLLER FOR GOOD VENTILATION. INSUFFICIENT CLEARANCE MAY CAUSE MALFUNCTION, BREAKDOWN OR FIRE.

■ Installation

To install the robot controller, observe the installation conditions and method described in the manual.

1. Installation

⚠WARNING

SECURELY TIGHTEN THE SCREWS FOR THE L-SHAPED BRACKETS USED TO INSTALL THE ROBOT CONTROLLER. IF NOT SECURELY TIGHTENED, THE SCREWS MAY COME LOOSE CAUSING THE CONTROLLER TO DROP.

2. Connections

⚠WARNING

- ALWAYS SHUT OFF ALL PHASES OF THE POWER SUPPLY EXTERNALLY BEFORE STARTING INSTALLATION OR WIRING WORK. FAILURE TO DO THIS MAY CAUSE ELECTRICAL SHOCK OR PRODUCT DAMAGE.
- NEVER DIRECTLY TOUCH CONDUCTIVE SECTIONS AND ELECTRONIC PARTS OTHER THAN THE CONNECTORS, ROTARY SWITCHES, AND DIP SWITCHES ON THE OUTSIDE PANEL OF THE ROBOT CONTROLLER. TOUCHING THEM MAY CAUSE ELECTRICAL SHOCK OR BREAKDOWN.
- SECURELY INSTALL EACH CABLE CONNECTOR INTO THE RECEPTACLES OR SOCKETS. POOR CONNECTIONS MAY CAUSE THE CONTROLLER OR ROBOT TO MALFUNCTION.

■ Wiring

1. Connection to robot controller

The controller parameters are preset at the factory before shipping to match the robot model. Check the specified robot and controller combination, and connect them in the correct combination.
Since the software detects abnormal operation such as motor overloads, the controller parameters must be set correctly to match the motor type used in the robot connected to the controller.

2. Wiring safety points

⚠WARNING

ALWAYS SHUT OFF ALL PHASES OF THE POWER SUPPLY EXTERNALLY BEFORE STARTING INSTALLATION OR WIRING WORK. FAILURE TO DO THIS MAY CAUSE ELECTRICAL SHOCK OR PRODUCT DAMAGE.

⚠CAUTION

- Make sure that no foreign matter such as cutting chips or wire scraps get into the robot controller. Malfunction, breakdown or fire may result if these penetrate inside.
- Do not apply excessive impacts or loads to the connectors when making cable connections. This might bend the connector pins or damage the internal PC board.
- When using ferrite cores for noise elimination, be sure to fit them onto the power cable as close to the robot controller and/or the robot as possible, to prevent malfunction caused by noise.

3. Wiring method

⚠WARNING

SECURELY INSTALL THE CONNECTORS INTO THE ROBOT CONTROLLER AND, WHEN WIRING THE CONNECTORS, MAKE THE CRIMP, PRESS-CONTACT OR SOLDER CONNECTIONS CORRECTLY USING THE TOOL SPECIFIED BY THE CONNECTOR MANUFACTURER.

⚠CAUTION

When disconnecting the cable from the robot controller, detach by gripping the connector itself and not by tugging on the cable. Loosen the screws on the connector (if fastened with the screws), and then disconnect the cable. Trying to detach by pulling on the cable itself may damage the connector or cables, and poor cable contact will cause the controller or robot to malfunction.

4. Precautions for cable routing and installation

⚠CAUTION

- Always store the cables connected to the robot controller in a conduit or clamp them securely in place. If the cables are not stored in a conduit or properly clamped, excessive play or movement or mistakenly pulling on the cable may damage the connector or cables, and poor cable contact will cause the controller or robot to malfunction.
- Do not modify the cables and do not place any heavy objects on them. Handle them carefully to avoid damage. Damaged cables may cause malfunction or electrical shock.
- If the cables connected to the robot controller may possibly become damaged, then protect them with a cover, etc.
- Check that the control lines and communication cables are routed at a gap sufficiently away from main power supply circuits and power lines, etc. Bundling them together with power lines or close to power lines may cause faulty operation due to noise.

5. Protective measures against electrical shock

⚠WARNING

BE SURE TO GROUND THE CONTROLLER USING THE GROUND TERMINAL ON THE POWER TERMINAL BLOCK. POOR GROUNDING MAY CAUSE ELECTRICAL SHOCK.

4.4 Safety measures

4.4.1 Safety measures

1. Referring to warning labels and manual

⚠WARNING

- **BEFORE STARTING INSTALLATION OR OPERATION OF THE ROBOT, BE SURE TO READ THE WARNING LABELS AND THIS MANUAL, AND COMPLY WITH THE INSTRUCTIONS.**
- **NEVER ATTEMPT ANY WORK OR OPERATION UNLESS DESCRIBED IN THIS MANUAL.**
- **NEVER ATTEMPT ANY REPAIR, PARTS REPLACEMENT AND MODIFICATION UNLESS DESCRIBED IN THIS MANUAL. THESE TASKS REQUIRE SPECIALIZED TECHNICAL KNOWLEDGE AND SKILLS AND MAY ALSO INVOLVE HAZARDS. PLEASE CONTACT YOUR DISTRIBUTOR FOR ADVICE.**

NOTE

For details on warning labels, see "3. Warning labels" in "Safety instructions."

2. Draw up "work instructions" and make the operators/workers understand them

⚠WARNING

DECIDE ON "WORK INSTRUCTIONS" IN CASES WHERE PERSONNEL MUST WORK WITHIN THE ROBOT MOVEMENT RANGE TO PERFORM STARTUP OR MAINTENANCE WORK. MAKE SURE THE WORKERS COMPLETELY UNDERSTAND THESE "WORK INSTRUCTIONS".

Decide on "work instructions" for the following items in cases where personnel must work within the robot movement range to perform teaching, maintenance or inspection tasks. Make sure the workers completely understand these "work instructions".

1. Robot operating procedures needed for tasks such as startup procedures and handling switches
2. Robot speeds used during tasks such as teaching
3. Methods for workers to signal each other when two or more workers perform tasks
4. Steps that the worker should take when a problem or emergency occurs
5. Steps to take after the robot has come to a stop when the emergency stop device was triggered, including checks for cancelling the problem or error state and safety checks in order to restart the robot.
6. In cases other than above, the following actions should be taken as needed to prevent hazardous situations due to sudden or unexpected robot operation or faulty robot operation as listed below.
   - Place a display sign on the operator panel
   - Ensure the safety of workers performing tasks within the robot movement range
   - Clearly specify position and posture during work
     Specify a position and posture where worker can constantly check robot movements and immediately move to avoid trouble if an error/problem occurs
   - Take noise prevention measures
   - Use methods for signaling operators of related equipment
   - Use methods to decide that an error has occurred and identify the type of error

Implement the "work instructions" according to the type of robot, installation location, and type of work task.
When drawing up the "work instructions" make an effort to include opinions from the workers involved, equipment manufacturer technicians, and workplace safety consultants, etc.

3. Take safety measures

⚠DANGER

- **NEVER ENTER THE ROBOT MOVEMENT RANGE WHILE THE ROBOT IS OPERATING OR THE MAIN POWER IS TURNED ON. FAILURE TO FOLLOW THIS WARNING MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH. INSTALL A SAFETY ENCLOSURE OR A GATE INTERLOCK WITH AN AREA SENSOR TO KEEP ALL PERSONS AWAY FROM THE ROBOT MOVEMENT RANGE.**
- **WHEN IT IS NECESSARY TO OPERATE THE ROBOT WHILE YOU ARE WITHIN THE ROBOT MOVEMENT RANGE SUCH AS FOR TEACHING OR MAINTENANCE/INSPECTION TASKS, ALWAYS CARRY THE PROGRAMMING BOX WITH YOU SO THAT YOU CAN IMMEDIATELY STOP THE ROBOT OPERATION IN CASE OF AN ABNORMAL OR HAZARDOUS CONDITION. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH.**

⚠WARNING

- DURING STARTUP OR MAINTENANCE TASKS, DISPLAY A SIGN "WORK IN PROGRESS" ON THE PROGRAMMING BOX AND OPERATION PANEL IN ORDER TO PREVENT ANYONE OTHER THAN THE PERSON FOR THAT TASK FROM MISTAKENLY OPERATING THE START OR SELECTOR SWITCH. IF NEEDED, TAKE OTHER MEASURES SUCH AS LOCKING THE COVER ON THE OPERATION PANEL.
- ALWAYS CONNECT THE ROBOT AND ROBOT CONTROLLER IN THE CORRECT COMBINATION. USING THEM IN AN INCORRECT COMBINATION MAY CAUSE FIRE OR BREAKDOWN.

4. Install system safeguards

When configuring an automated system using a robot, hazardous situations are more likely to occur from the automated system than the robot itself. So the system manufacturer should install the necessary safety measures required for the individual system. The system manufacturer should provide a proper manual for safe, correct operation and servicing of the system.

⚠WARNING

TO CHECK THE ROBOT CONTROLLER OPERATING STATUS, REFER TO THIS MANUAL AND TO RELATED MANUALS. DESIGN AND INSTALL THE SYSTEM INCLUDING THE ROBOT CONTROLLER SO THAT IT WILL ALWAYS WORK SAFELY.

5. Precautions for operation

⚠WARNING

- DO NOT TOUCH ANY ELECTRICAL TERMINAL. DIRECTLY TOUCHING THESE TERMINALS MAY CAUSE ELECTRICAL SHOCK, EQUIPMENT DAMAGE, AND MALFUNCTION.
- DO NOT TOUCH OR OPERATE THE ROBOT CONTROLLER OR PROGRAMMING BOX WITH WET HANDS. TOUCHING OR OPERATING THEM WITH WET HANDS MAY RESULT IN ELECTRICAL SHOCK OR BREAKDOWN.

6. Do not disassemble and modify

⚠WARNING

NEVER DISASSEMBLE AND MODIFY ANY PART IN THE ROBOT, CONTROLLER, AND PROGRAMMING BOX. DO NOT OPEN ANY COVER. DOING SO MAY CAUSE ELECTRICAL SHOCK, BREAKDOWN, MALFUNCTION, INJURY, OR FIRE.

4.4.2 Installing a safety enclosure

Be sure to install a safety enclosure to keep anyone from entering within the movement range of the robot. The safety enclosure will prevent the operator and other persons from coming in contact with moving parts of the robot and suffering injury.

⚠DANGER

SERIOUS INJURY MAY RESULT FROM CONTACT WITH A MOVING ROBOT.

- KEEP OUTSIDE OF THE ROBOT SAFETY ENCLOSURE DURING OPERATION.
- PRESS THE EMERGENCY STOP BUTTON BEFORE ENTERING THE SAFETY ENCLOSURE.

⚠WARNING

- INSTALL AN INTERLOCK THAT TRIGGERS EMERGENCY STOP WHEN THE DOOR OR GATE OF THE SAFETY ENCLOSURE IS OPENED.
- THE SAFETY ENCLOSURE SHOULD BE DESIGNED SO THAT NO ONE CAN ENTER INSIDE EXCEPT FROM THE DOOR OR GATE EQUIPPED WITH AN INTERLOCK DEVICE.
- WARNING LABEL 1 (SEE "3. WARNING LABELS" IN "SAFETY INSTRUCTIONS") THAT COMES SUPPLIED WITH A ROBOT SHOULD BE AFFIXED TO AN EASY-TO-SEE LOCATION ON THE DOOR OR GATE OF THE SAFETY ENCLOSURE.

4.5 Operation

When operating a robot, ignoring safety measures and checks may lead to serious accidents. Always take the following safety measures and checks to ensure safe operation.

⚠DANGER

CHECK THE FOLLOWING POINTS BEFORE STARTING ROBOT OPERATION.
- **NO ONE IS WITHIN THE ROBOT MOVEMENT RANGE.**
- **THE PROGRAMMING UNIT IS IN THE SPECIFIED LOCATION.**
- **THE ROBOT AND PERIPHERAL EQUIPMENT ARE IN GOOD CONDITION.**

4.5.1 Trial operation

After installing, adjusting, inspecting, maintaining or repairing the robot, perform trial operation using the following procedures.

1. If a safety enclosure has not yet been provided right after installing the robot:

then rope off or chain off the movement range around the robot in place of the safety enclosure and observe the following points.

⚠DANGER

PLACE A "ROBOT IS MOVING - KEEP AWAY!" SIGN TO KEEP THE OPERATOR OR OTHER PERSONNEL FROM ENTERING WITHIN THE MOVEMENT RANGE OF THE ROBOT.

⚠WARNING

- **USE STURDY, STABLE POSTS WHICH WILL NOT FALL OVER EASILY.**
- **THE ROPE OR CHAIN SHOULD BE EASILY VISIBLE TO EVERYONE AROUND THE ROBOT.**

2. Check the following points before turning on the controller.

- Is the robot securely and correctly installed?
- Are the electrical connections to the robot wired correctly?
- Are items such as air pressure correctly supplied?
- Is the robot correctly connected to peripheral equipment?
- Have safety measures (safety enclosure, etc.) been taken?
- Does the installation environment meet the specified standards?

3. After the controller is turned on, check the following points from outside the safety enclosure.

- Does the robot start, stop and enter the selected operation mode as intended?
- Does each axis move as intended within the soft limits?
- Does the end effector move as intended?
- Are the correct signals being sent to the end effector and peripheral equipment?
- Does emergency stop function?
- Are teaching and playback functions normal?
- Are the safety enclosure and interlocks functioning as intended?

4. Working inside safety enclosures

Before starting work within the safety enclosure, **always first confirm from outside the enclosure that each safety function is operating correctly (see the previous section 2.3)**.

⚠ DANGER

NEVER ENTER WITHIN THE MOVEMENT RANGE WHILE WITHIN THE SAFETY ENCLOSURE.

⚠ WARNING

WHEN WORK IS REQUIRED WITHIN THE SAFETY ENCLOSURE, PLACE A SIGN "WORK IN PROGRESS" IN ORDER TO KEEP OTHER PERSONS FROM OPERATING THE CONTROLLER SWITCH OR OPERATION PANEL.

⚠ WARNING

WHEN WORK WITHIN THE SAFETY ENCLOSURE IS REQUIRED, ALWAYS TURN OFF THE CONTROLLER POWER EXCEPT FOR THE FOLLOWING CASES:

Exception

Work with power turned on, but robot in emergency stop

Origin position setting	**SCARA robots**	Follow the precautions and procedure described in "2. Adjusting the origin position" in Chapter 3.
Reference coordinate setting	**SCARA robots**	Follow the precautions and procedure described in "4. Setting the reference coordinates" in Chapter 3.
Soft limit settings	**SCARA robots**	Follow the precautions and procedure described in "3. Setting the soft limits" in Chapter 3.
	Cartesian robots **Single-axis robots**	Follow the precautions and procedure described in "Soft limit" in each controller manual.

Work with power turned on

Teaching	**SCARA robots** **Cartesian robots** **Single-axis robots**	Refer to "5. Teaching within safety enclosure" described below.

5. Teaching within the safety enclosure

When performing teaching within the safety enclosure, check or perform the following points **from outside the safety enclosure**.

⚠ DANGER

NEVER ENTER WITHIN THE MOVEMENT RANGE WHILE WITHIN THE SAFETY ENCLOSURE.

⚠ WARNING

- MAKE A VISUAL CHECK TO ENSURE THAT NO HAZARDS ARE PRESENT WITHIN THE SAFETY ENCLOSURE.
- CHECK THAT THE PROGRAMMING BOX OR HANDY TERMINAL OPERATES CORRECTLY.
- CHECK THAT NO FAILURES ARE FOUND IN THE ROBOT.
- CHECK THAT EMERGENCY STOP WORKS CORRECTLY.
- SELECT TEACHING MODE AND DISABLE AUTOMATIC OPERATION.

4.5.2 Automatic operation

Check the following points when operating the robot in AUTO mode. Observe the instructions below in cases where an error occurs during automatic operation. Automatic operation described here includes all operations in AUTO mode.

1. Checkpoints before starting automatic operation

Check the following points before starting automatic operation

⚠DANGER

- CHECK THAT NO ONE IS WITHIN THE SAFETY ENCLOSURE.
- CHECK THE SAFETY ENCLOSURE IS SECURELY INSTALLED WITH INTERLOCKS FUNCTIONAL.

⚠WARNING

- CHECK THAT THE PROGRAMMING BOX / HANDY TERMINAL AND TOOLS ARE IN THEIR SPECIFIED LOCATIONS.
- CHECK THAT THE ALARM OR ERROR LAMPS ON THE ROBOT AND PERIPHERAL EQUIPMENT ARE NOT LIT OR FLASHING.

2. During automatic operation and when errors occur

After automatic operation starts, check the operation status and the signal tower to ensure that the robot is in automatic operation.

⚠DANGER

NEVER ENTER THE SAFETY ENCLOSURE DURING AUTOMATIC OPERATION.

⚠WARNING

IF AN ERROR OCCURS IN THE ROBOT OR PERIPHERAL EQUIPMENT, OBSERVE THE FOLLOWING PROCEDURE BEFORE ENTERING THE SAFETY ENCLOSURE.

1) PRESS THE EMERGENCY STOP BUTTON TO SET THE ROBOT TO EMERGENCY STOP.
2) PLACE A SIGN ON THE START SWITCH, INDICATING THAT THE ROBOT IS BEING INSPECTED IN ORDER TO KEEP OTHER PERSONS FROM RESTARTING THE ROBOT.

4.5.3 Precautions during operation

1. When the robot is damaged or an abnormal condition occurs

⚠WARNING

- IF UNUSUAL ODORS, NOISE OR SMOKE OCCUR DURING OPERATION, IMMEDIATELY TURN OFF POWER TO PREVENT POSSIBLE ELECTRICAL SHOCK, FIRE OR BREAKDOWN. STOP USING THE ROBOT AND CONTACT YOUR DISTRIBUTOR.
- IF ANY OF THE FOLLOWING DAMAGE OR ABNORMAL CONDITIONS OCCURS THE ROBOT, THEN CONTINUING TO OPERATE THE ROBOT IS DANGEROUS. IMMEDIATELY STOP USING THE ROBOT AND CONTACT YOUR DISTRIBUTOR.

Damage or abnormal condition	Type of danger
Damage to machine harness or robot cable	Electrical shock, robot malfunction
Damage to robot exterior	Damaged parts fly off during robot operation
Abnormal robot operation (position deviation, vibration, etc.)	Robot malfunction
Z-axis (vertical axis) or brake malfunction	Loads fall off

2. High temperature hazard

⚠WARNING

- DO NOT TOUCH THE ROBOT CONTROLLER AND ROBOT DURING OPERATION. THE ROBOT CONTROLLER AND ROBOT BODY ARE VERY HOT DURING OPERATION, SO BURNS MAY OCCUR IF THESE SECTIONS ARE TOUCHED.
- THE MOTOR AND SPEED REDUCTION GEAR CASING ARE VERY HOT SHORTLY AFTER OPERATION, SO BURNS MAY OCCUR IF THESE ARE TOUCHED. BEFORE TOUCHING THOSE PARTS FOR INSPECTIONS OR SERVICING, TURN OFF THE CONTROLLER, WAIT FOR A WHILE AND CHECK THAT THEIR TEMPERATURE HAS COOLED.

3. Use caution when releasing the Z-axis (vertical axis) brake

⚠WARNING

THE VERTICAL AXIS WILL SLIDE DOWNWARD WHEN THE BRAKE IS RELEASED, CAUSING A HAZARDOUS SITUATION.

- PRESS THE EMERGENCY STOP BUTTON AND PLACE A SUPPORT UNDER THE VERTICAL AXIS BEFORE RELEASING THE BRAKE.
- BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE VERTICAL AXIS AND THE INSTALLATION BASE WHEN RELEASING THE BRAKE TO PERFORM DIRECT TEACH.

4. Be careful of Z-axis movement when the controller is turned off or emergency stop is triggered (air-driven Z-axis)

⚠WARNING

THE Z-AXIS STARTS MOVING UPWARD WHEN POWER TO THE CONTROLLER OR PLC IS TURNED OFF, THE PROGRAM IS RESET, EMERGENCY STOP IS TRIGGERED, OR AIR IS SUPPLIED TO THE SOLENOID VALVE FOR THE Z-AXIS AIR CYLINDER.

- DO NOT LET HANDS OR FINGERS GET CAUGHT AND SQUEEZED BY ROBOT PARTS MOVING ALONG THE Z-AXIS.
- KEEP THE USUAL ROBOT POSITION IN MIND SO AS TO PREVENT THE Z-AXIS FROM HANGING UP OR BINDING ON OBSTACLES DURING RAISING OF THE Z-AXIS EXCEPT IN CASE OF EMERGENCY STOP.

5. Take protective measures when the Z-axis interferes with peripheral equipment (air-driven Z-axis)

⚠WARNING

WHEN THE Z-AXIS COMES TO A STOP DUE TO OBSTRUCTION FROM PERIPHERAL EQUIPMENT, THE Z-AXIS MAY MOVE SUDDENLY AFTER THE OBSTRUCTION IS REMOVED, CAUSING INJURY SUCH AS PINCHED OR CRUSHED HANDS.

- TURN OFF THE CONTROLLER AND REDUCE THE AIR PRESSURE BEFORE ATTEMPTING TO REMOVE THE OBSTRUCTION.
- BEFORE REDUCING THE AIR PRESSURE, PLACE A SUPPORT UNDER THE Z-AXIS BECAUSE THE Z-AXIS WILL DROP UNDER ITS OWN WEIGHT.

6. Be careful of Z-axis movement when air supply is stopped (air-driven Z-axis)

⚠WARNING

THE Z-AXIS WILL SLIDE DOWNWARD WHEN THE AIR PRESSURE TO THE Z-AXIS AIR CYLINDER SOLENOID VALVE IS REDUCED, CREATING A HAZARDOUS SITUATION.
TURN OFF THE CONTROLLER AND PLACE A SUPPORT UNDER THE Z-AXIS BEFORE CUTTING OFF THE AIR SUPPLY.

7. Make correct parameter settings

⚠CAUTION

The robot must be operated with the correct tolerable moment of inertia and acceleration coefficients that match the manipulator tip mass and moment of inertia. Failure to follow this instruction will lead to a premature end to the drive unit service life, damage to robot parts, or cause residual vibration during positioning.

8. If the X-axis, Y-axis or R-axis rotation angle is small

⚠CAUTION

If the X-axis, Y-axis or R-axis rotation angle is set smaller than 5 degrees, then it will always move within the same position. This restricted position makes it difficult for an oil film to form on the joint support bearing, and so may possibly damage the bearing. In this type of operation, add a range of motion so that the joint moves through 90 degrees or more, about 5 times a day.

4.6 Inspection and maintenance

Always perform daily and periodic inspections and make a pre-operation check to ensure there are no problems with the robot and related equipment. If a problem or abnormality is found, then promptly repair it or take other measures as necessary.
Keep a record of periodic inspections or repairs and store this record for at least 3 years.

4.6.1 Before inspection and maintenance work

1. Do not attempt any work or operation unless described in this manual.

Never attempt any work or operation unless described in this manual.
If an abnormal condition occurs, please be sure to contact your distributor. Our service personnel will take appropriate action.

⚠WARNING

- NEVER ATTEMPT INSTALLATION, ADJUSTMENT, INSPECTION AND MAINTENANCE UNLESS DESCRIBED IN THIS MANUAL.
- NEVER ATTEMPT ANY REPAIR AND PARTS REPLACEMENT UNLESS DESCRIBED IN THIS MANUAL. THESE TASKS REQUIRE SPECIALIZED TECHNICAL KNOWLEDGE AND SKILLS AND MAY ALSO INVOLVE HAZARDS. PLEASE BE SURE TO CONTACT YOUR DISTRIBUTOR FOR ADVICE.

2. Precautions during repair and parts replacement

⚠WARNING

WHEN IT IS NECESSARY TO REPAIR OR REPLACE PARTS OF THE ROBOT OR CONTROLLER, PLEASE BE SURE TO CONTACT YOUR DISTRIBUTOR AND FOLLOW THE INSTRUCTIONS THEY PROVIDE. INSPECTION AND MAINTENANCE OF THE ROBOT OR CONTROLLER BY AN UNSKILLED, UNTRAINED PERSON IS EXTREMELY HAZARDOUS.

Adjustment, maintenance and parts replacement require specialized technical knowledge and skills, and also may involve hazards. These tasks must be performed only by persons who have enough ability and qualifications required by local laws and regulations.

⚠WARNING

ADJUSTMENT AND MAINTENANCE BY REMOVING A COVER REQUIRE SPECIALIZED TECHNICAL KNOWLEDGE AND SKILLS, AND MAY ALSO INVOLVE HAZARDS IF ATTEMPTED BY AN UNSKILLED PERSON. FOR DETAILED INFORMATION, PLEASE CONTACT YOUR DISTRIBUTOR WHERE YOU PURCHASED THE PRODUCT.

3. Shut off all phases of power supply

⚠WARNING

ALWAYS SHUT OFF ALL PHASES OF THE POWER SUPPLY EXTERNALLY BEFORE CLEANING THE ROBOT AND CONTROLLER OR SECURELY TIGHTENING THE TERMINAL SCREWS ETC. FAILURE TO DO THIS MAY CAUSE ELECTRICAL SHOCK OR PRODUCT DAMAGE OR MALFUNCTION.

4. Allow a waiting time after power is shut off (Allow time for temperature and voltage to drop)

⚠WARNING

- WHEN PERFORMING MAINTENANCE OR INSPECTION OF THE ROBOT CONTROLLER UNDER YOUR DISTRIBUTOR'S INSTRUCTIONS, WAIT AT LEAST 30 MINUTES FOR THE RCX SERIES OR 5 MINUTES FOR THE SR1 SERIES AFTER TURNING THE POWER OFF. SOME COMPONENTS IN THE ROBOT CONTROLLER ARE VERY HOT OR STILL RETAIN A HIGH VOLTAGE SHORTLY AFTER OPERATION, SO BURNS OR ELECTRICAL SHOCK MAY OCCUR IF THOSE PARTS ARE TOUCHED.
- THE MOTOR AND SPEED REDUCTION GEAR CASING ARE VERY HOT SHORTLY AFTER OPERATION, SO BURNS MAY OCCUR IF THEY ARE TOUCHED. BEFORE TOUCHING THOSE PARTS FOR INSPECTIONS OR SERVICING, TURN OFF THE CONTROLLER, WAIT FOR A WHILE AND CHECK THAT THE TEMPERATURE HAS COOLED.

5. Precautions during inspection of controller

⚠WARNING

- WHEN YOU NEED TO TOUCH THE TERMINALS OR CONNECTORS ON THE OUTSIDE OF THE CONTROLLER DURING INSPECTION, ALWAYS FIRST TURN OFF THE CONTROLLER POWER SWITCH AND ALSO THE POWER SOURCE IN ORDER TO PREVENT POSSIBLE ELECTRICAL SHOCK.
- DO NOT DISASSEMBLE THE CONTROLLER. NEVER TOUCH ANY INTERNAL PARTS OF THE CONTROLLER. DOING SO MAY CAUSE BREAKDOWN, MALFUNCTION, INJURY, OR FIRE.

4.6.2 Precautions during service work

1. Precautions when removing a motor (Cartesian robots and vertical mount single-axis robots)

⚠WARNING

THE VERTICAL AXIS WILL SLIDE DOWN WHEN THE MOTOR IS REMOVED, CAUSING A HAZARDOUS SITUATION.
- TURN OFF THE CONTROLLER AND PLACE A SUPPORT UNDER THE VERTICAL AXIS BEFORE REMOVING THE MOTOR.
- BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BY THE DRIVING UNIT OF THE VERTICAL AXIS OR BETWEEN THE VERTICAL AXIS AND THE INSTALLATION BASE.

2. Be careful when removing the Z-axis motor (SCARA robots)

⚠WARNING

THE Z-AXIS WILL SLIDE DOWNWARD WHEN THE Z-AXIS MOTOR IS REMOVED, CAUSING A HAZARDOUS SITUATION.
- TURN OFF THE CONTROLLER AND PLACE A SUPPORT UNDER THE Z-AXIS BEFORE REMOVING THE Z-AXIS MOTOR.
- BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BY THE DRIVING UNIT OF THE Z-AXIS OR BETWEEN THE Z-AXIS DRIVE UNIT AND THE INSTALLATION BASE.

3. Do not remove the Z-axis upper limit mechanical stopper

⚠CAUTION

Warning label 4 is attached to each SCARA robot. (For details on warning labels, see "3. Warning labels" in "Safety instructions.")
Removing the upper limit mechanical stopper installed to the Z-axis spline or shifting its position will damage the Z-axis ball screw. Never attempt to remove it.

4. Use caution when handling a robot that contains powerful magnets

⚠WARNING

POWERFUL MAGNETS ARE INSTALLED INSIDE THE ROBOT. DO NOT DISASSEMBLE THE ROBOT SINCE THIS MAY CAUSE INJURY. DEVICES THAT MAY MALFUNCTION DUE TO MAGNETIC FIELDS MUST BE KEPT AWAY FROM THIS ROBOT.

5. Use the following caution items when disassembling or replacing the pneumatic equipment.

⚠WARNING

AIR OR PARTS MAY FLY OUTWARD IF PNEUMATIC EQUIPMENT IS DISASSEMBLED OR PARTS REPLACED WHILE AIR IS STILL SUPPLIED.
- DO SERVICE WORK AFTER TURNING OFF THE CONTROLLER, REDUCING THE AIR PRESSURE, AND EXHAUSTING THE RESIDUAL AIR FROM THE PNEUMATIC EQUIPMENT.
- BEFORE REDUCING THE AIR PRESSURE, PLACE A SUPPORT STAND UNDER THE Z-AXIS (2-AXIS ROBOTS WITH AIR DRIVEN Z-AXIS) SINCE IT WILL DROP UNDER ITS OWN WEIGHT.

6. Use caution to avoid contact with the controller cooling fan

⚠WARNING

- TOUCHING THE ROTATING FAN MAY CAUSE INJURY.
- IF REMOVING THE FAN COVER, FIRST TURN OFF THE CONTROLLER AND MAKE SURE THE FAN HAS STOPPED.

7. Precautions for robot controllers

⚠CAUTION

- Back up the robot controller internal data on an external storage device. The robot controller internal data (programs, point data, etc.) may be lost or deleted for unexpected reasons. Always make a backup of this data.
- Do not use thinner, benzene, or alcohol to wipe off the surface of the programming box. The surface sheet may be damaged or printed letters or marks erased. Use a soft, dry cloth and gently wipe the surface.
- Do not use a hard or pointed object to press the keys on the programming box. Malfunction or breakdown may result if the keys are damaged. Use your fingers to operate the keys.
- Do not insert any SD memory card other than specified into the SD memory card slot in the programming box. Malfunction or breakdown may result if the wrong memory card is inserted.

4.7 Disposal

When disposing of robots and related items, handle them carefully as industrial wastes. Use the correct disposal method in compliance with your local regulations, or entrust disposal to a licensed industrial waste disposal company.

1. Disposal of lithium batteries

When disposing of lithium batteries, use the correct disposal method in compliance with your local regulations, or entrust disposal to a licensed industrial waste disposal company. We do not collect and dispose of the used batteries.

2. Disposal of packing boxes and materials

When disposing of packing boxes and materials, use the correct disposal method in compliance with your local regulations. We do not collect and dispose of the used packing boxes and materials.

3. Strong magnet

⚠WARNING

STRONG MAGNETS ARE INSTALLED IN THE ROBOT. BE CAREFUL WHEN DISPOSING OF THE ROBOT.

5. Emergency action when a person is caught by robot

If a person should get caught between the robot and a mechanical part such as the installation base, then release the axis.

Emergency action

Release the axis while referring to the following section in the manual for the robot controller.

Controller	Refer to:
RCX240	Section 8, "Freeing a person caught by the robot" in Chapter 1

NOTE

Make a printout of the relevant page in the manual and post it a conspicuous location near the controller.

6. Using the robot safely

6.1 Robot safety functions

Safety functions for YAMAHA robots are described below.

1. Overload detection

This function detects an overload applied to the motor and shuts off the servo power.

If an overload error occurs, take the following measures to avoid such errors:

1. Insert a timer in the program.
2. Reduce the acceleration coefficient.

2. Overheat detection

This function detects an abnormal temperature rise in the driver inside the controller and shuts off the servo power.

If an overheat error occurs, take the following measures to avoid the error:

1. Insert a timer in the program.
2. Reduce the acceleration coefficient.

3. Soft limits

Soft limits can be set on each axis to limit the working envelope in manual operation after return-to-origin and during automatic operation. The working envelope is the area limited by soft limits.

⚠WARNING

SOFT LIMITS MUST BE SET WITHIN THE MOVEMENT RANGE (MECHANICAL STOPPER). IF THE SOFT LIMIT IS SET OUTSIDE THE MOVEMENT RANGE, THEN THE ROBOT AXIS MAY COLLIDE WITH THE MECHANICAL STOPPER AT HIGH SPEED, CAUSING THE OBJECT GRIPPED BY THE END EFFECTOR TO FLY OUTWARD OR DROP, AND THE ROBOT TO MALFUNCTION.

4. Mechanical stoppers

If the servo power is shut off by emergency stop operation or safety function while the robot is moving, then these mechanical stoppers prevent the axis from exceeding the movement range. No mechanical stopper is provided on the rotational axis. The movement range is the area limited by the mechanical stoppers.

- The X and Y axes have mechanical stoppers that are installed at both ends of the maximum movement range. Some robot models have a standard feature that allows changing the mechanical stopper positions. On some other models, the mechanical stopper positions can also be changed by using option parts.
- The Z-axis has a mechanical stopper at the upper end and lower end. The stopper positions can be changed by using option parts.
- No mechanical stopper is provided on the R-axis.

⚠WARNING

AXIS MOVEMENT DOES NOT STOP IMMEDIATELY AFTER THE SERVO POWER SUPPLY IS SHUT OFF BY EMERGENCY STOP OR OTHER SAFETY FUNCTIONS.

5. Z-axis (vertical axis) brake

An electromagnetic brake is installed on the Z-axis to prevent the Z-axis from sliding downward when servo power is OFF. This brake is working when the controller is OFF or the Z-axis servo power is OFF even when the controller is ON. The Z-axis brake can be released by the programming unit / handy terminal or by a command in the program when the controller is ON.

⚠WARNING

THE VERTICAL AXIS WILL SLIDE DOWNWARD WHEN THE Z-AXIS BRAKE IS RELEASED, CREATING A HAZARDOUS SITUATION.

- **PRESS THE EMERGENCY STOP BUTTON AND PLACE A SUPPORT UNDER THE VERTICAL AXIS BEFORE RELEASING THE BRAKE.**
- **BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE VERTICAL AXIS AND INSTALLATION BASE WHEN RELEASING THE BRAKE TO PERFORM DIRECT TEACH.**

6.2 Special training for industrial robot operation

Operators or persons who handle the robot for tasks such as for teaching, programming, movement checks, inspections, adjustments, and repairs must receive appropriate training and also have the skills needed to perform the job correctly and safely. They must also read the manual carefully to understand its contents before attempting the robot operation or maintenance.

Tasks related to industrial robots (teaching, programming, movement check, inspection, adjustment, repair, etc.) must be performed by qualified persons who meet requirements established by local regulations and safety standards for industrial robots.

This manual does not serve as a guarantee of any industrial property rights or any other rights and does not grant a license in any form. Please acknowledge that we bear no liability whatsoever for any problems involving industrial property rights which may arise from the contents of this manual.

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Revision record

Manual version	Issue date	Description
Ver. 1.00	May 2012	First edition
Ver. 1.01	Jun. 2012	Description of "Emergency action when a person is caught by robot" was added, the work sequence for working within the safety enclosure changed, typing errors corrected, etc.

YAMAHA Safety Instructions

Jun. 2012
Ver. 1.01
This manual is based on Ver. 1.01 of Japanese manual.

YAMAHA MOTOR CO., LTD. IM Operations

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Information furnished by YAMAHA in this manual is believed to be reliable. However, no responsibility is assumed for possible inaccuracies or omissions. If you find any part unclear in this manual, please contact your distributor.

Warranty

For information on the warranty period and terms, please contact our distributor where you purchased the product.

This warranty does not cover any failure caused by:

1. Installation, wiring, connection to other control devices, operating methods, inspection or maintenance that does not comply with industry standards or instructions specified in the YAMAHA manual;
2. Usage that exceeded the specifications or standard performance shown in the YAMAHA manual;
3. Product usage other than intended by YAMAHA;
4. Storage, operating conditions and utilities that are outside the range specified in the manual;
5. Damage due to improper shipping or shipping methods;
6. Accident or collision damage;
7. Installation of other than genuine YAMAHA parts and/or accessories;
8. Modification to original parts or modifications not conforming to standard specifications designated by YAMAHA, including customizing performed by YAMAHA in compliance with distributor or customer requests;
9. Pollution, salt damage, condensation;
10. Fires or natural disasters such as earthquakes, tsunamis, lightning strikes, wind and flood damage, etc;
11. Breakdown due to causes other than the above that are not the fault or responsibility of YAMAHA;

The following cases are not covered under the warranty:

1. Products whose serial number or production date (month & year) cannot be verified.
2. Changes in software or internal data such as programs or points that were created or changed by the customer.
3. Products whose trouble cannot be reproduced or identified by YAMAHA.
4. Products utilized, for example, in radiological equipment, biological test equipment applications or for other purposes whose warranty repairs are judged as hazardous by YAMAHA.

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Introduction

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Before using the robot (Be sure to read the following notes.)

Thank you for purchasing YAMAHA SCARA ROBOT YK-XGC(P) series.
This manual describes only the points that are different from the standard models.
For details about other explanations, see the Installation Manual and Maintenance Manual for YK-XG series standard models.

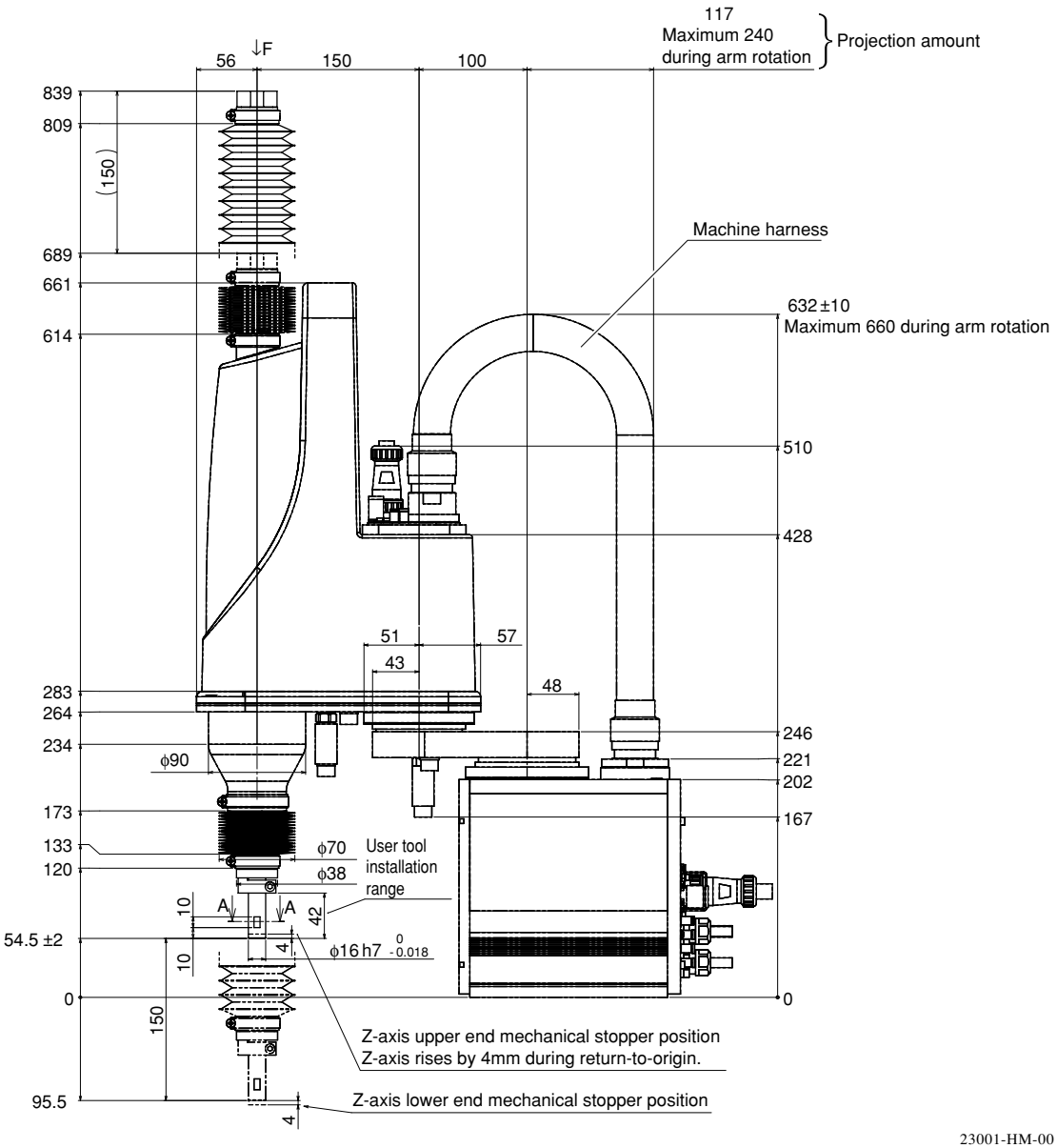
1. If the Z-axis spline vibrates.

The Z-axis spline of the YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), and YK600XGLC(P) tends to vibrate in a Z-axis operation speed range of 20% to 40%. If the Z-axis spline vibrates, operate it beyond this operation speed range.

2. If the machine harness projects toward the base rear side.

In the YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), and YK600XGLC(P), the machine harness may project toward the base rear side according to the arm position.
The maximum projection amount is described in "1.2 External view and dimensions" in Chapter 5. So, refer to this section for further information.

Projection of the machine harness toward the base rear side (Example: YK250XGC(P))



23001-HM-00

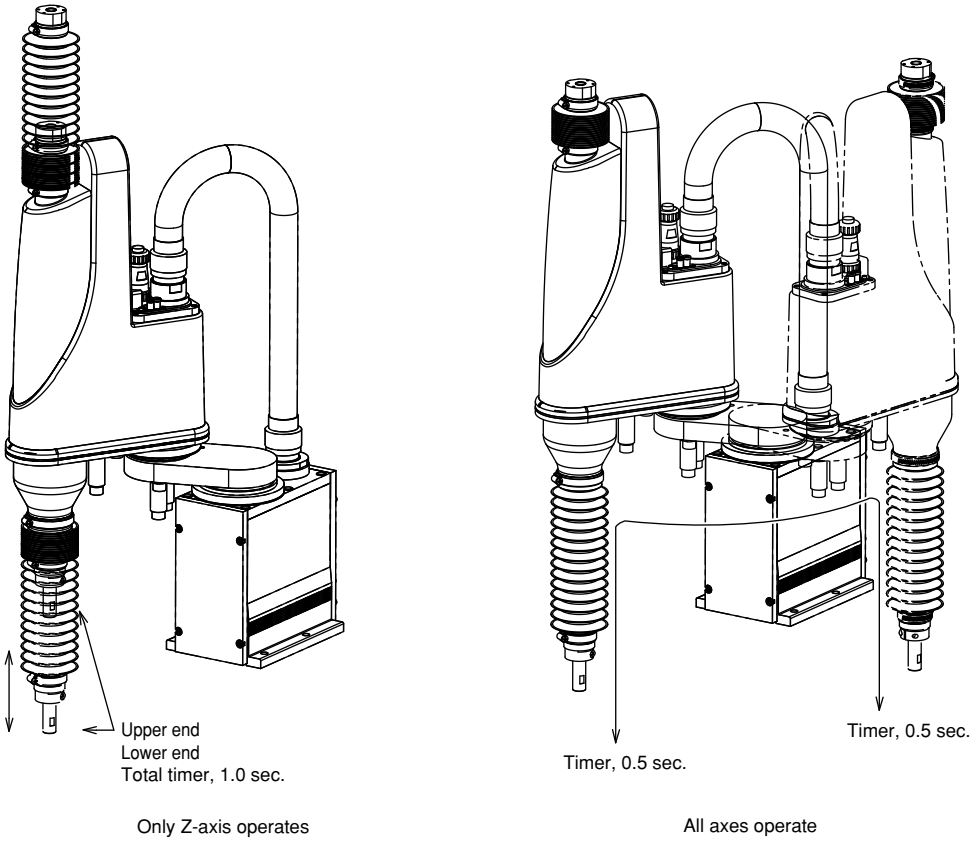
⚠CAUTION

If there is an interference object on the base rear side, be sure to keep a sufficient space.

3. Put timer during Z-axis operation.

If the tip load attached to the spline tip of the YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), or YK600XGLC(P) exceeds 2kg, the Z-axis may be overloaded depending on the operation pattern.
In this case, put a timer during operation as shown in the Fig. below to prevent overload of the Z-axis. The reference timer values are shown below. Furthermore, the maximum payload is 4kg. If the tip load exceeds this maximum payload, the Z-axis may be overloaded easily. So, do not operate the robot with a tip load exceeding 4kg.

Putting timer during Z-axis operation



Only Z-axis operates

All axes operate

23002-HM-00

4. Z-axis additional mechanical stopper

The Z-axis additional mechanical stopper cannot be installed in the YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), and YK600XGLC(P) as they are equipped with bellows.

5. Detach or attach the Y-axis arm cover.

The Y-axis arm cover cannot be detached or attached unless the Z-axis is moved down to its lower end. For details, see "9. Detaching or attaching the covers" in Chapter 2.

Introduction

This manual describes YAMAHA industrial robots YK-XGC series clean room models (YK250XGC to YK600XGLC) and YK-XGP series dust/drip proof models (YK250XGP to YK600XGLP).

This manual describes the safety measures, handling, adjustment and maintenance of XGC(P) series robots for correct, safe and effective use. Be sure to read this manual carefully before installing the robot. Even after you have read this manual, keep it in a safe and convenient place for future reference. This manual should be used with the robot and considered an integral part of it. When the robot is moved, transferred or sold, send this manual to the new user along with the robot. Be sure to explain to the new user the need to read through this manual.

For explanations not described in this manual, see the Installation Manual and Maintenance Manual for YK-XG series. Additionally, for details about safety instructions, see also these manuals.
If you have any questions, contact your distributor.

For details about actual robot operation and programming, refer to the "YAMAHA Robot Controller User's Manual".

⚠WARNING

THE ADJUSTMENT AND MAINTENANCE WORK WITH THE COVER REMOVED NEEDS THE SPECIAL KNOWLEDGE AND SKILL. IF UNSKILLED WORK PERSON PERFORMS SUCH WORK, THIS MAY INVOLVE RISK.
THESE TASKS MUST BE PERFORMED ONLY BY PERSONS WHO HAVE ENOUGH ABILITY AND QUALIFICATIONS IN ACCORDANCE WITH LOCAL LAWS AND REGULATIONS, BY REFERRING TO THE SEPARATE MAINTENANCE MANUAL.
FOR DETAILED INFORMATION, PLEASE CONTACT YOUR DISTRIBUTOR WHERE YOU PURCHASED THE PRODUCT.

NOTES

- The contents of this manual are subject to change without prior notice.
- Information furnished by YAMAHA in this manual is believed to be reliable.
  However, if you find any part unclear or inaccurate in this manual, please contact your distributor.

YAMAHA MOTOR CO., LTD.
IM Operations

Chapter 1 Functions

Contents

1. Robot manipulator 1-1
1.1 Manipulator movement 1-1
1.2 Part names 1-2
2. Robot initialization number list 1-3

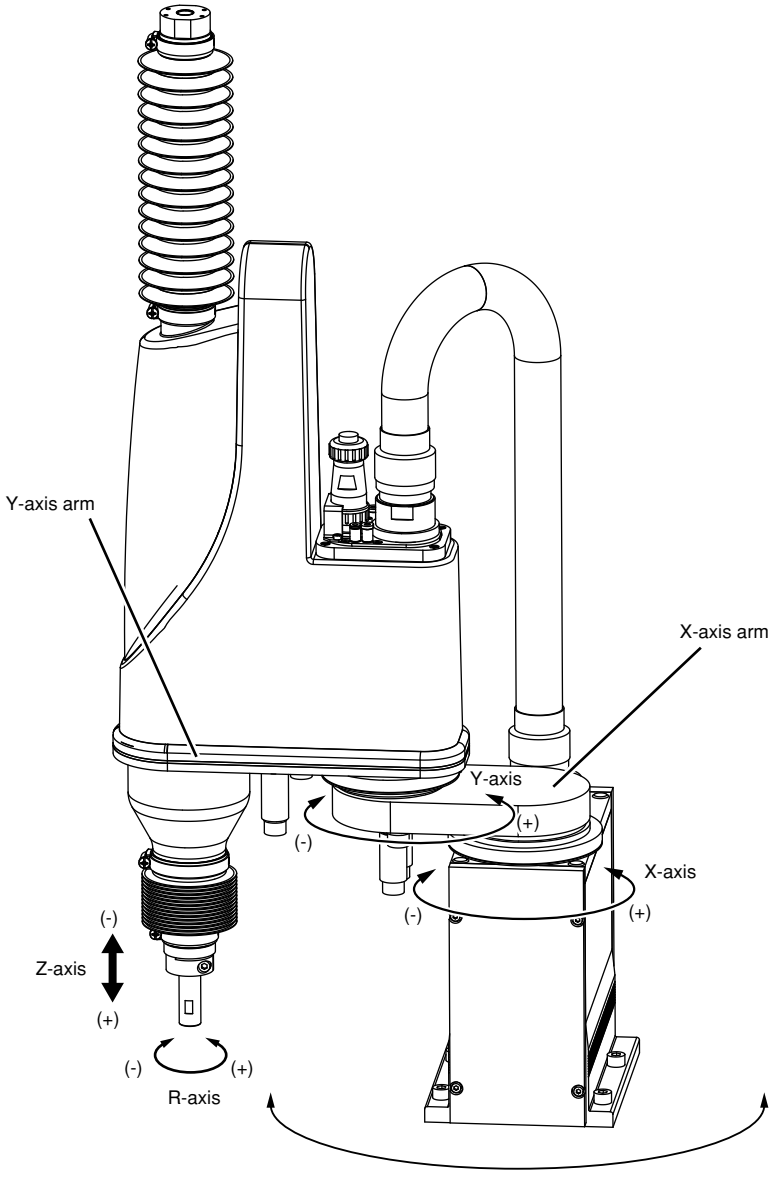
1. Robot manipulator

This Chapter describes only the points that are different from the standard models.
For details about other explanations, see the Installation Manual for YK-XG series standard models.

1.1 Manipulator movement

The YK-XG series robots are available in 4-axis models having an X/Y-axis arm (equivalent to human arm) and a Z/R-axis (equivalent to human wrist). With these 4 axes, the YK-XG series robots can move as shown in the Fig. below. By attaching different types of end effector (gripper) to the end of the arm, a wide range of tasks can be performed with high precision at high speeds. The (+) and (-) signs show the direction of axis movement when the jog keys on the programming box are pressed (standard setting at the factory).

Manipulator movement



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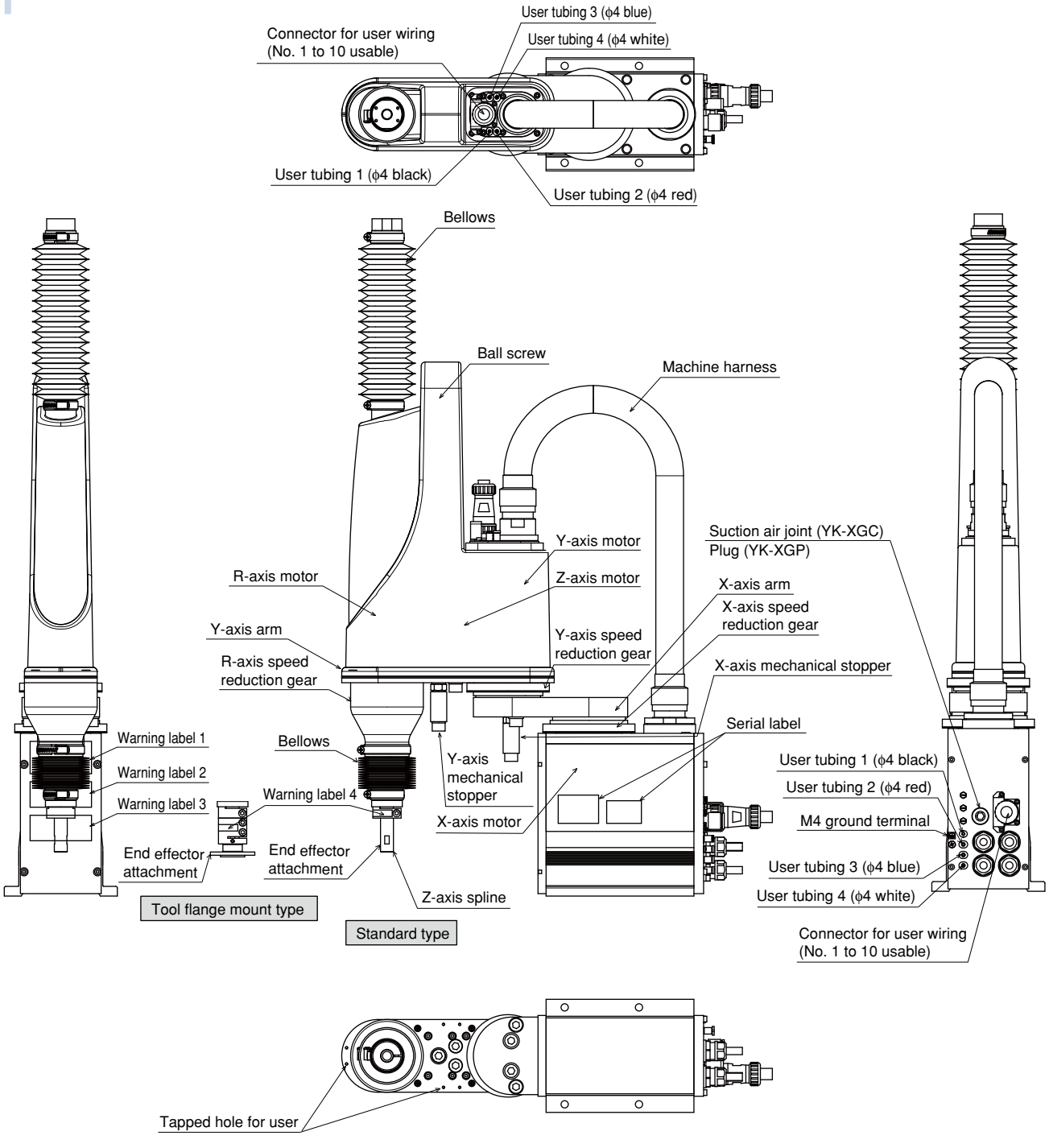
1.2 Part names

YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), YK600XGLC(P)



2. Robot initialization number list

The XGC(P) series robots are initialized for optimum setting (default setting) according to the robot model prior to shipping. The robot controllers do not have to be reinitialized during normal operation. However, if for some reason the controller must be reinitialized, proceed while referring to the list below.

⚠CAUTION

- **Absolute reset must be performed after reinitializing the controller. Before reinitializing the controller, read the descriptions stated in "2. Absolute reset" in Chapter 4 of the Installation Manual for YK-XG series standard models and make sure you thoroughly understand the procedure.**
- **When the controller is initialized, the "ARM LENGTH" and "OFFSET PULSE" settings in the axis parameters will be erased, making the standard coordinate settings invalid. (For details about standard coordinates, see "4. Setting the standard coordinates" in Chapter 3 of the Installation Manual for YK-XG series standard models.) If you do not want to change the origin position by initializing, make a note of the "ARM LENGTH" and "OFFSET PULSE" settings before initializing, and re-enter their settings after initialization is complete.**

Robot initialization number	Model name
2300	YK250XGC, YK250XGP
2301	YK350XGC, YK350XGP
2302	YK400XGC, YK400XGP
2303	YK500XGLC, YK500XGLP
2304	YK600XGLC, YK600XGLP

Chapter 2 Installation

Contents

1. Robot installation conditions 2-1
   - 1.1 Sucking from the base rear side of the clean room model 2-1
   - 1.2 Protection ratings for moisture and dust on dust/drip proof models 2-2
2. Installation 2-3
   - 2.1 Checking the product 2-3
   - 2.2 Moving the robot 2-4
3. User wiring and user tubing 2-6
4. Limiting the movement range with x- and y-axis mechanical stoppers 2-9
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5. Limiting the movement range with Z-axis mechanical stopper 2-13
6. Working envelope and mechanical stopper positions for maximum working envelope 2-13
7. Installing the user wiring and tubing newly 2-14
8. Passing the user wiring and tubing through the spline 2-15
9. Detaching or attaching the covers 2-16
10. Installing the tool flange 2-21

1. Robot installation conditions

The installation conditions for the clean room models are identical to the standard models.
The installation conditions for the dust/drip proof models are identical to the standard models except for the moisture and dust conditions.

NOTE

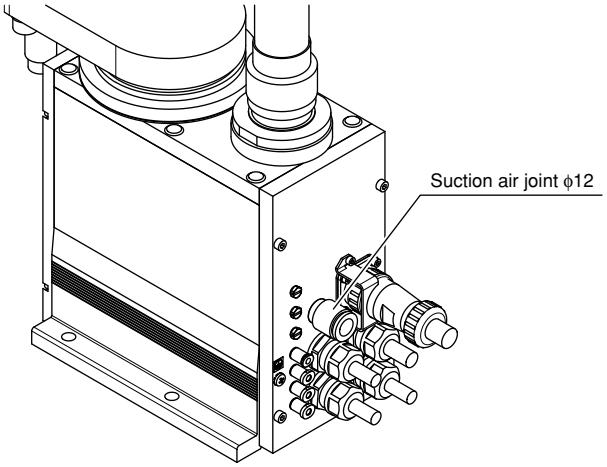
This Chapter describes only the points that are different from the standard models.
For details about other explanations, see the Installation Manual for YK-XG series standard models.

1.1 Sucking from the base rear side of the clean room model

Suck from the suction air joint on the base rear side at a suction air flow of 30Nℓ/min. as shown in the Fig. below.
If the Z-axis bellows become dented when sucking, reduce the suction air flow.

Suction air joint

Clean room model



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1.2 Protection ratings for moisture and dust on dust/drip proof models

The protection ratings for moisture and dust on the YK250XGP, YK350XGP, YK400XGP, YK500XGLP, and YK600XGLP dust/drip proof models are equivalent to IP65.

⚠WARNING

- **DO NOT IMMERSE AND USE THE ROBOT OR ANY PART OF THE ROBOT IN WATER. OTHERWISE, WATER MAY PENETRATE INSIDE THE ROBOT.**
- **DO NOT USE THE ROBOT IN AN ENVIRONMENT EXCEEDING THE LISTED LEVELS OF PROTECTION FOR DUST AND MOISTURE. OTHERWISE, WATER OR DUST MAY PENETRATE INSIDE THE ROBOT.**
- **DO NOT SPLASH THE JET FLOW ONTO THE BELLOWS DIRECTLY.**
  FOR DETAILS ABOUT DRIP PROOF PERFORMANCE FOR FLUID OTHER THAN WATER, CONTACT YOUR DISTRIBUTOR.

IP 6 5

Degree of protection versus water penetration : 5
At level 5, water injected from an optional angle does not exert a harmful effect.
Water injection pressure per the standards is 30kPa (30kN/m², 0.3kgf/cm²)
Injection speed is 12.5 liters per minute, at a time interval of 3 minutes.

Water may penetrate inside the robot if the water pressure is higher than this level.

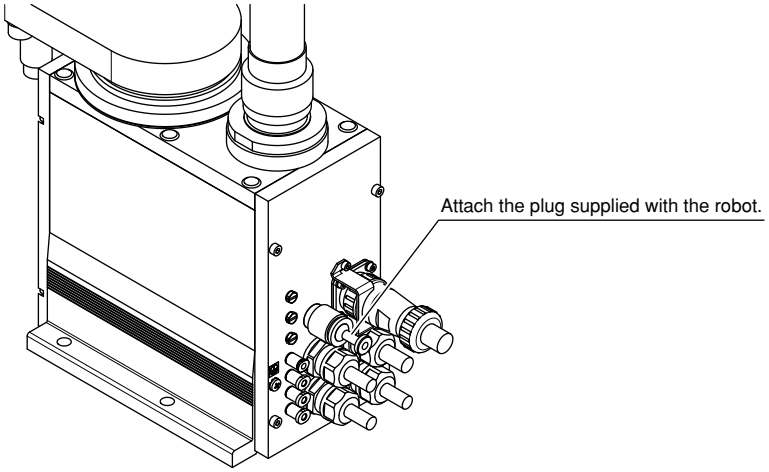
Degree of protection versus solid debris : 6
At level 6 there is no dust penetration.

⚠CAUTION

For dust/drip proof models, attach the plug supplied with the robot to ϕ12-joint on the base rear side. If the plug is not attached, dust, etc. may penetrate inside the robot. (See also the Fig. below.)

Attaching the plug

Dust/drip proof model



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2. Installation

2.1 Checking the product

After unpacking, check the product configuration and conditions.
The following configurations are typical examples, so please check that the product is as specified in your order.

⚠CAUTION

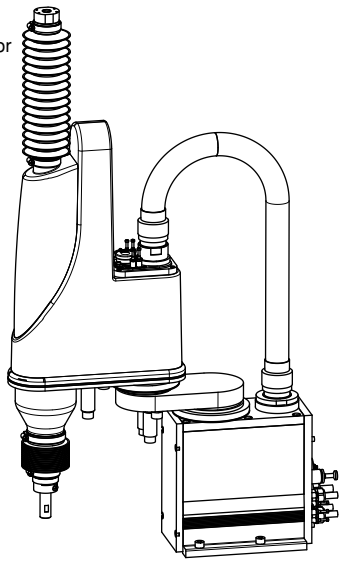
If there is any damage due to transportation or insufficient parts, please notify your distributor immediately.

● Controller : RCX240
Robot : YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), YK600XGLC(P)

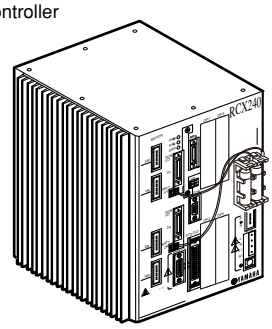
Product configurations

Standard

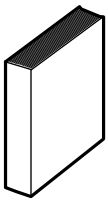
Robot manipulator



RCX240 controller



CD-ROM User's Manual
or
User's Manual

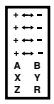


Warning label (×1)

Mounting bracket (×2)

Connector for user wiring (×2)

Origin position stickers



Standard coordinate
setting jig (option)

Option

RPB programming box, etc.

2.2 Moving the robot

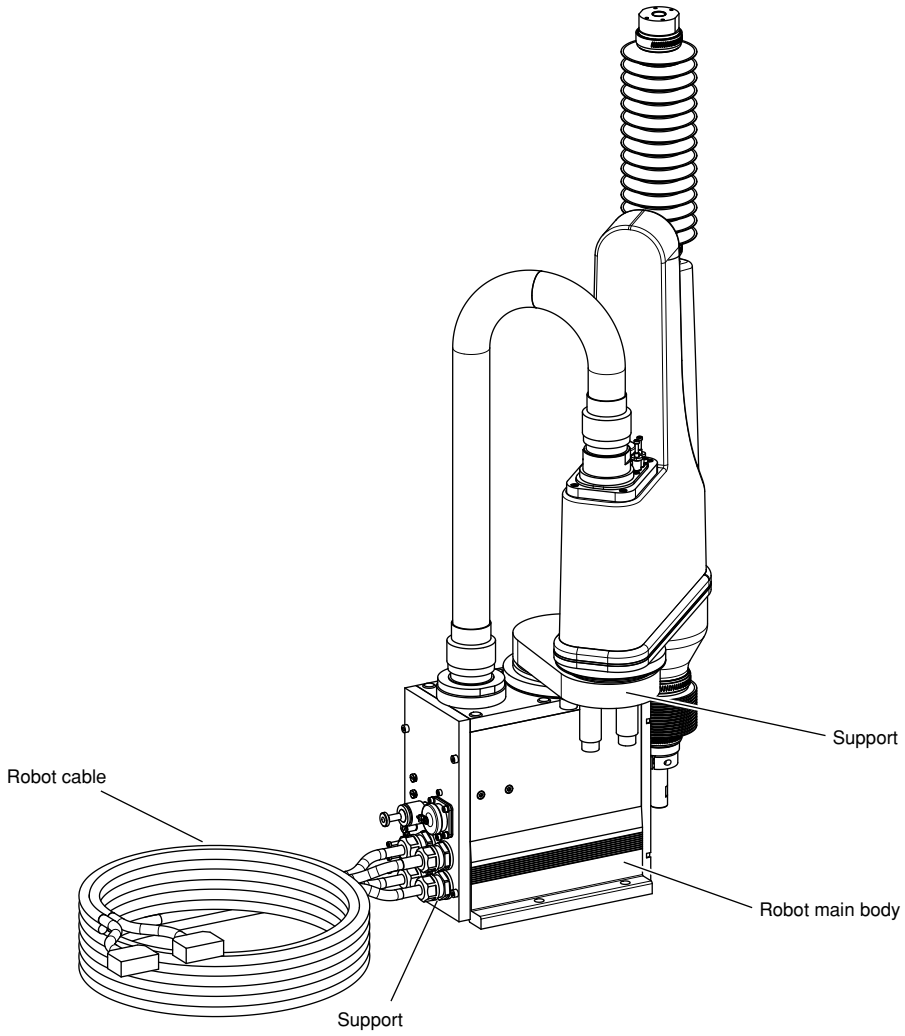
⚠WARNING

SERIOUS INJURY MAY OCCUR IF THE ROBOT FALLS AND PINS SOMEONE UNDER IT.
- DO NOT ALLOW ANY PART OF YOUR BODY TO ENTER THE AREA BENEATH THE ROBOT DURING WORK.
- ALWAYS WEAR A HELMET, SAFETY SHOES AND GLOVES DURING WORK.

To check the mass of each robot, refer to "1.1 Basic specifications" in Chapter 5.

Step1 Fold the arms while referring to the Fig. below.

Moving the robot



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Step2 Place the robot on the base.

One work person holds the support of the robot main body with both hands and other work person holds the robot cable to place the robot on the base.

Step3 Temporarily secure the robot by tightening the bolts.

Step 4 *Secure the robot main body firmly.*

Secure the robot main body firmly with the four hex socket head bolts as shown in the Fig. below.

⚠WARNING

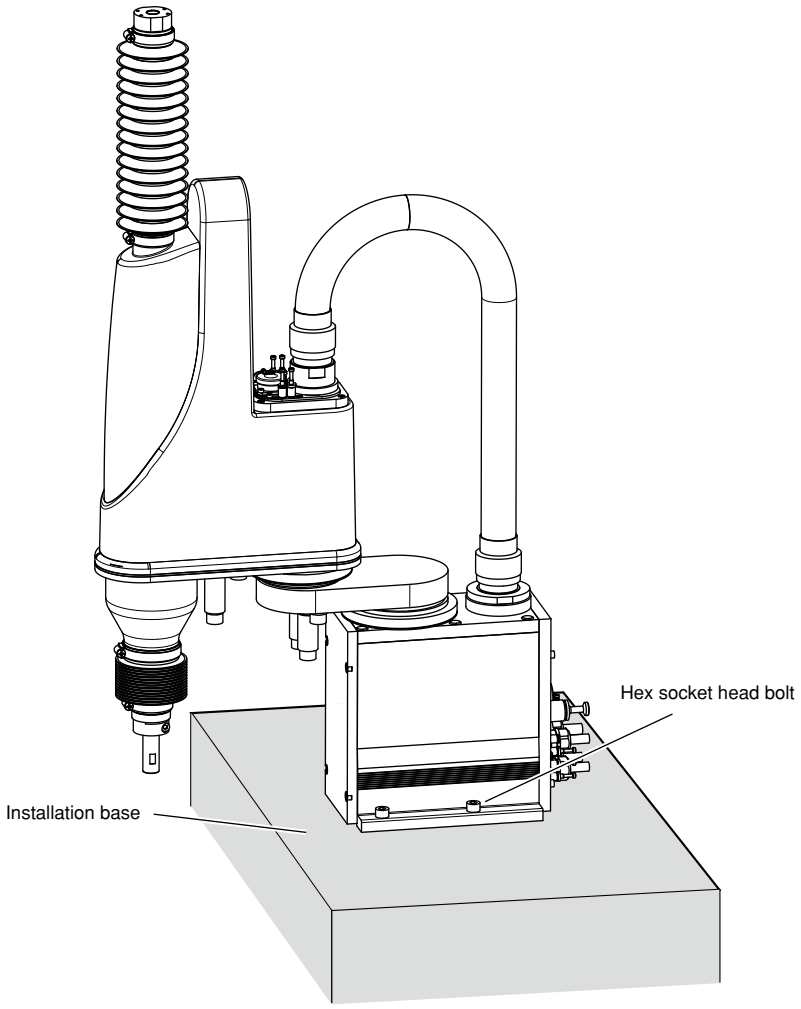
WHEN INSTALLING THE ROBOT, BE SURE TO USE THE SPECIFIED SIZE AND QUANTITY OF BOLTS THAT MATCH THE DEPTH OF TAPPED HOLES IN THE INSTALLATION BASE, AND SECURELY TIGHTEN THE BOLTS TO THE CORRECT TORQUE. IF THE BOLTS ARE NOT TIGHTENED CORRECTLY, THE ROBOT MIGHT FALL OVER DURING OPERATION CAUSING A SERIOUS ACCIDENT.

Tightening torque

Robot Model	Bolts Used	Tightening torque
YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), YK600XGLC(P)	M8	37Nm (380kgfcm)

Depth of tapped holes in installation base:
Iron installation base : Bolt diameter × 1.5 or more
Aluminum installation base Bolt diameter × 3.0 or more
Recommended bolt : JIS B 1176 hex socket head bolt, or equivalent
Strength class JIS B 1051 12.9, or equivalent

Installing the robot



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3. User wiring and user tubing

⚠ WARNING

ALWAYS TURN OFF THE CONTROLLER AND SHUT OFF AIR SUPPLY BEFORE ATTEMPTING WIRING AND PIPING WORK. IF AIR OR POWER IS SUPPLIED DURING THIS WORK, THE MANIPULATOR MAY MOVE ERRONEOUSLY CAUSING A HAZARDOUS SITUATION.

The YK-XGC(P) series robots are equipped with user wires and air tubes in the machine harness. The table below shows the number of wires and air tubes available for each robot model.

Robot Model	User wiring	User tubing
YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), YK600XGLC(P)	10 wires	ϕ4, 4 tubes

* Robot models for custom specifications may have different wiring or tubing.

The specifications of the user wires and air tubes are shown below. Always observe the specifications.

User Wiring

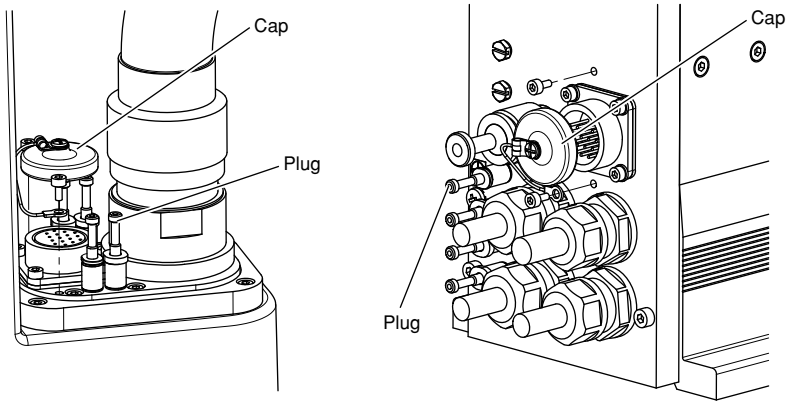
Rated voltage	30V
Allowable current	1.5A
Nominal cross-section area of conductor	0.2mm^2
Shield	Yes

User Tubing

Maximum pressure	0.58MPa (6Kgf/cm^2)
Outer diameter × inner diameter	ϕ4mm × ϕ2.5mm
Fluid	Dry clean air not containing deteriorated compressor oil; filtration 40μm or less

Connector for the user wiring and joint for the user tubing are provided on each of the arm and base sides. For details about locations, see "1.2 External view and dimensions" in Chapter 5.
If the connector for the user wiring and the joint for the user tubing of the YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), or YK600XGLC(P) are not used, attach the cap and plug, respectively. Otherwise, moisture or dust may penetrate inside the robot. (See the Fig. below.)

Plug and cap



Y-axis arm side　　Base side

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Signal wiring connections in the machine harness

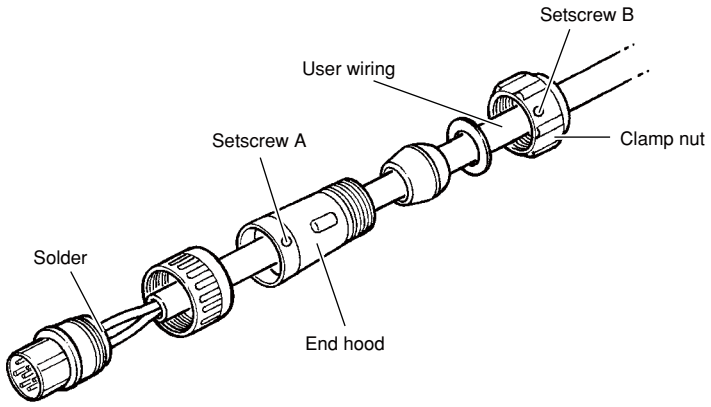
- YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), YK600XGLC(P)
  Connector pins 1 to 10 can be used.

Signal	Connector	NO	Connection	NO	Connector	Color
User signal line	I O (Arm side)	1		1	I O (Base side)	Brown
		2		2		Red
		3		3		Orange
		4		4		Blue
		5		5		Violet
		6		6		Grey
		7		7		White
		8		8		Brown
		9		9		Red
		10		10		Orange
		11		11		
		12		12		
		13		13		
		14		14		
		15		15		Grey
Flame Ground				1	FG	Grey

* Robots models with non-standard specifications may have different wiring colors.

The following describes how to make the wiring to the connector supplied with the robot.
Solder the user signal wires to the connector as shown in Fig. below and assemble the connector. Then, connect it to the user wiring connector. Tighten each connector screw to its specified torque. If the outer diameter of the cable is small, use tape or an equivalent item to thicken the cable clamp. Otherwise, moisture and dust may penetrate inside the robot.

Wiring



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- **Screw tightening torque**

Position	Torque value (kgf • cm)
End hood	10 to 15
Clamp nut	15 to 20
Setscrews A and B	2 to 3

- **Cable outer diameter**

Model	Cable outer diameter (mm)
YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), YK600XGLC(P)	ϕ13.1 to 15.0

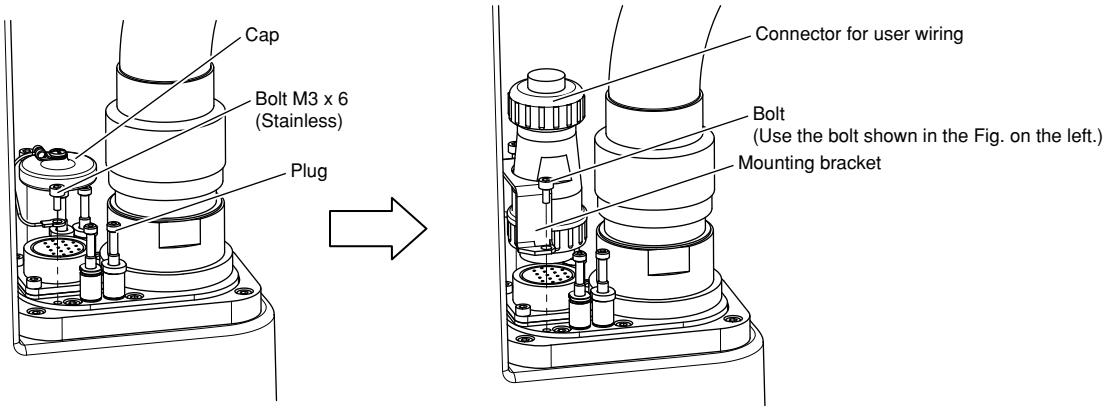
⚠WARNING

- SECURE THE CONNECTOR FOR THE USER WIRING (SUPPLIED) FIRMLY WITH THE MOUNTING BRACKET (SUPPLIED). IF THIS CONNECTOR COMES OFF, THIS MAY CAUSE THE ROBOT TO MALFUNCTION. (SEE THE FIG. BELOW.)
- TAKE APPROPRIATE MEASURES SO THAT THE WIRING OR TUBING PREPARED BY THE USER THAT HAS BEEN INSTALLED USING THE CONNECTOR FOR THE USER WIRING OR THE JOINT FOR THE USER TUBING DOES NOT INTERFERE WITH THE ROBOT, ENTANGLE AROUND THE ROBOT, OR FLAP AROUND DURING ROBOT OPERATION. OTHERWISE, THE WIRING OR TUBING IS DAMAGED, CAUSING MALFUNCTION.
- LAY OUT THE WIRING OR TUBING PREPARED BY THE USER THAT HAS BEEN INSTALLED USING THE CONNECTOR FOR THE USER WIRING OR THE JOINT FOR THE USER TUBING SO THAT IT DOES NOT HINDER THE MOVEMENT OF WORK PERSONNEL. OTHERWISE, WORK PERSONNEL MAY STUMBLE OVER THE WIRING OR TUBING, CAUSING FALLING OR PERSONAL INJURY.

⚠CAUTION

- **For the connector for the user wiring supplied with the robot, pin contacts are connected to the connector on the arm side while socket contacts are connected to the connector on the base side. Pay special attention to this instruction when performing the soldering.**
- **Be sure to use the connector for the user wiring supplied with the robot. If other connector is used, contact fault may occur.**

Connector for user wiring (Y-axis arm side)



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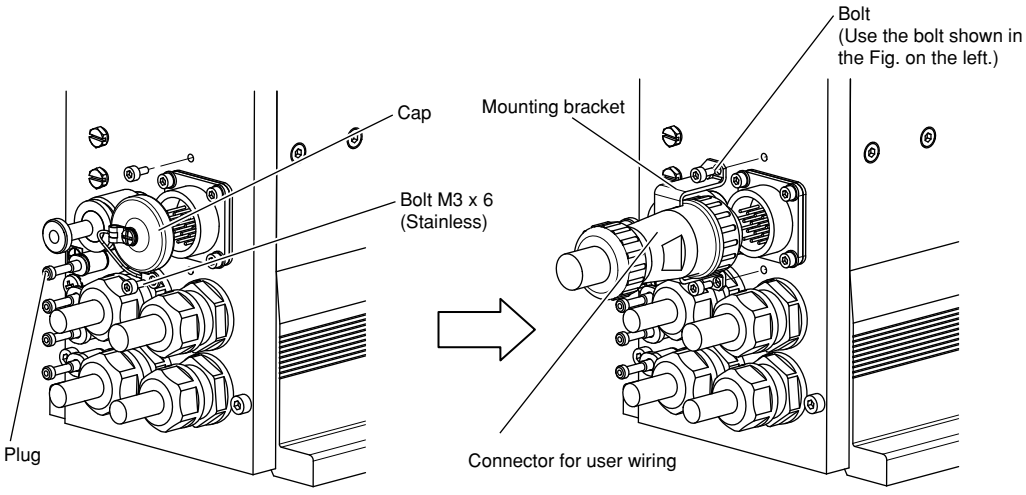
Connector for user wiring (base side)



23209-HM-00

Connector for user wiring supplied with the robot at shipment

Robot Model	Connector for user wiring on arm side	Connector for user wiring on base side
YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), YK600XGLC(P)	NJW-24-16-PM-15	NJW-24-16-PF-15

Manufacturer: MISUMI or NANABOSHI ELECTRIC MFG

To check the operation and signal transmission between the end effector and the controller or peripheral equipment after making connections, refer to the section "4.5.1 Trial Operation" in Chapter "Safety Instructions" of this manual.

4. Limiting the movement range with X- and Y-axis mechanical stoppers

⚠WARNING

ALWAYS TURN OFF THE CONTROLLER BEFORE CHANGING THE MOVEMENT RANGE WITH MECHANICAL STOPPERS.

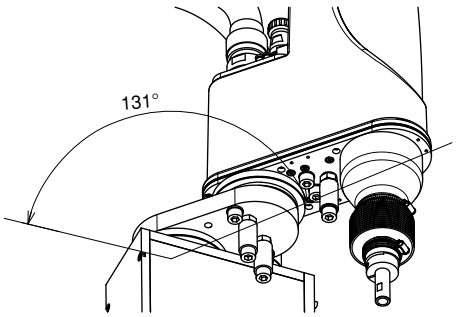
⚠CAUTION

When the mechanical stopper positions are changed, the soft limits must be set to a point inside the mechanical stopper positions. For details about soft limits, see "3. Setting the soft limits" in Chapter 3 of the Installation Manual for YK-XG standard model.

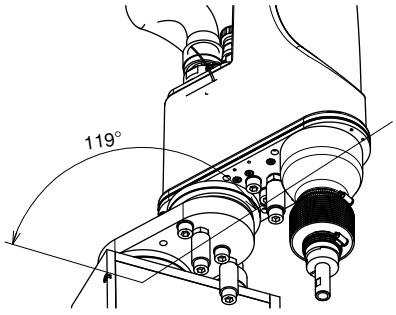
If the working envelope during robot work is smaller than the maximum working envelope range or if the robot interferes with peripheral units, the movement range is limited. (When the robot is shipped from factory, the movement range is set to the maximum level.)
The movement range can be limited by shifting the X-axis and Y-axis mechanical stopper positions. Follow the steps below to limit the movement range.

The following shows the mechanical stopper positions and movement range.

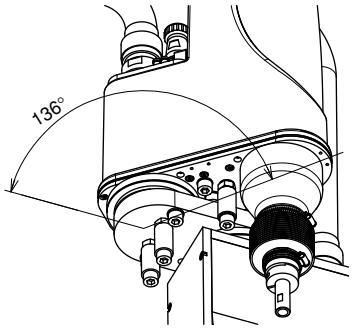
Mechanical stopper position and maximum movement position



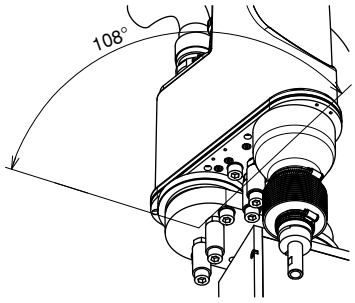
X-axis standard stopper position



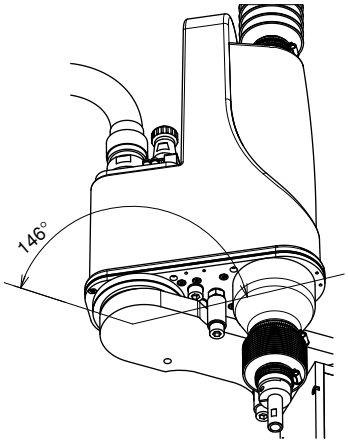
X-axis additional stopper position



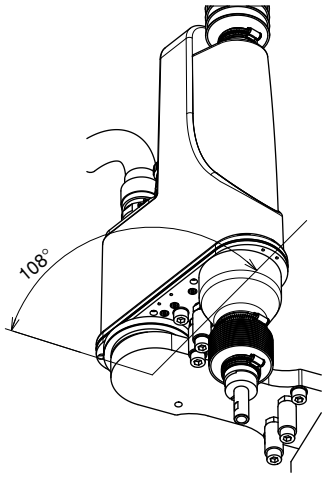
Y-axis standard stopper position
(YK250XGC(P), YK350XGC(P))



Y-axis additional stopper position
(YK250XGC(P), YK350XGC(P))



Y-axis standard stopper position
(YK400XGC(P), YK500XGLC(P), YK600XGLC(P))



Y-axis additional stopper position
(YK400XGC(P), YK500XGLC(P), YK600XGLC(P))

As option parts are ordered, and then they are installed, the movement ranges of the X-axis and Y-axis can be narrowed.
The movement range of the X-axis can be narrowed by moving only the existing stopper.

NOTE

Note that the stopper position may slightly deviate due to the part machining accuracy and mounting position.

After changing the mechanical stopper positions, set the soft limits to the values shown below.

■ Soft limits

	Standard stopper	Additional stopper
Stopper position in X-axis plus or minus direction	131°	119°
Maximum movement position in X-axis plus or minus direction	129°	117°
Stopper position in Y-axis plus or minus direction	136° (YK250XGC(P), YK350XGC(P)) 146° (YK400XGC(P), YK500XGLC(P), YK600XGLC(P))	108°
Maximum movement position in Y-axis plus or minus direction	134° (YK250XGC(P), YK350XGC(P)) 144° (YK400XGC(P), YK500XGLC(P), YK600XGLC(P))	106°

■ Soft limits after setting additional stopper

	Soft limit (pulses)	Movement range
Working envelope in X-axis plus direction	425984	117°
Working envelope in X-axis minus direction	-425984	-117°
Working envelope in Y-axis plus direction	385934	106°
Working envelope in Y-axis minus direction	-385934	-106°

4.1 Installing the X-axis/Y-axis additional mechanical stoppers

Follow the steps below to install the X-axis/Y-axis additional mechanical stoppers.
Install the X-axis additional mechanical stopper by moving only the existing stopper.
Use the optional bolts and nuts listed below to install the Y-axis additional mechanical stopper.

	No.	Part No.	Q'ty	Remarks
Additional mechanical stopper parts in either one direction of Y-axis plus or minus direction or both directions (*1)	1	KCY-M2197-000	1	Stopper damper
	2	90990-01J067	1	Bolt
	3	90189-00J106	1	Nut
	4	90990-36J010	3	Seal washer

*1 : Only one set of parts shown above is used even when the stopper is added in either plus or minus direction or both directions.
(When adding the stopper in both directions, the existing stopper is also used after moving it.)

The X-axis and Y-axis mechanical stoppers can be individually installed in the X-axis and Y-axis plus and minus directions.
The following describes how to install the mechanical stopper using the stopper in the X-axis and Y-axis plus direction as an example. (The stopper in the minus direction can also be installed in the same manner.)

⚠CAUTION

When adding the stopper in one direction of the Y-axis, do not remove the standard stopper. If this stopper is removed, the stopper on the opposite side is lost.

Step 1 ***Turn off the controller.***

Step 2 ***Place a sign indicating the robot is being adjusted.***

Place a sign indicating the robot is being adjusted, to keep others from touching the controller switch.

Step 3 Enter the safety enclosure.

Step 4 Remove the bolts, seal washers, and washers.

Remove the tapped-hole plug bolts, seal washers, and washers. Additionally, remove the stopper from the plus side of the X-axis.

23211-HM-00

Step 5 Sandwich the damper among the bolt, nut, and seal washer, and secure the parts.

1. Sandwich the damper (1) among the bolt (2), nut (3), and seal washer (4). At this time, use the bolt and nut listed in the Table on the previous page.
2. Secure the parts to the arm by tightening the nut to the specified torque (42Nm (428kgfcm)).

23212-HM-00

⚠CAUTION

When adding the stopper in one direction of the Y-axis, do not remove the standard stopper. If this stopper is removed, the stopper on the opposite side is lost.

Step 6 Install the bolt and washer in the blank tapped hole in the standard stopper.

To protect the blank tapered hole in the standard stopper, tighten the bolt and washer to the specified torque (16Nm (163kgfcm)).

23213-HM-00

⚠CAUTION

Be sure to put the seal washer (4). Otherwise, the dust/drip proof performance or the degree of cleanliness may lower.

Step 7 Check that the movement range is limited.

Step 8 Go out of the safety enclosure.

Step 9 Turn on the controller.

Check that no one is inside the safety enclosure, and then turn on the controller.

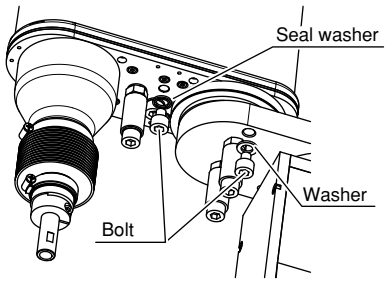
Step 10 Set the soft limits in the X-axis and Y-axis plus directions.

When the stopper is installed in the minus direction, set the soft limits in the minus direction.

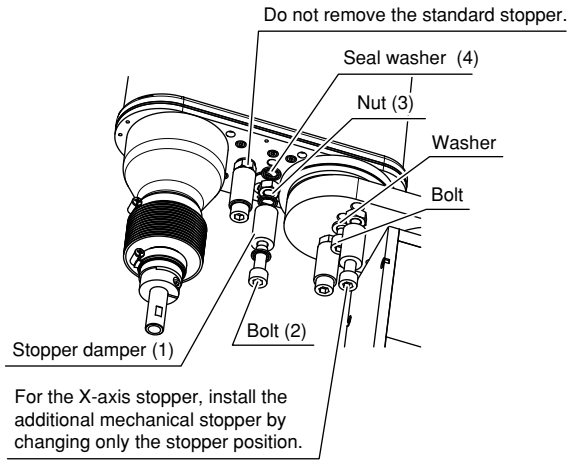
⚠CAUTION

Whether or not the X-axis stops at a position before the stopper limited by the soft limit must be checked from the outside of the safety enclosure.

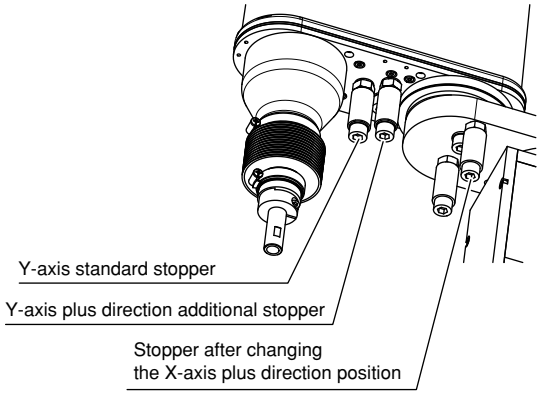
Step 4 Removing the tapped-hole plug bolts and seal washer



Step 5 Installing the damper


Do not remove the standard stopper.
Seal washer (4)
Nut (3)
Washer
Bolt
Bolt (2)
Stopper damper (1)
For the X-axis stopper, install the additional mechanical stopper by changing only the stopper position.

Step 6 Installing the bolt in the standard stopper


Y-axis standard stopper
Y-axis plus direction additional stopper
Stopper after changing the X-axis plus direction position

Step 11 Check that the X-axis and Y-axis stop firmly.

Whether or not the X-axis stops at a position before the stopper limited by the maximum soft limit must be checked from the outside of the safety enclosure.

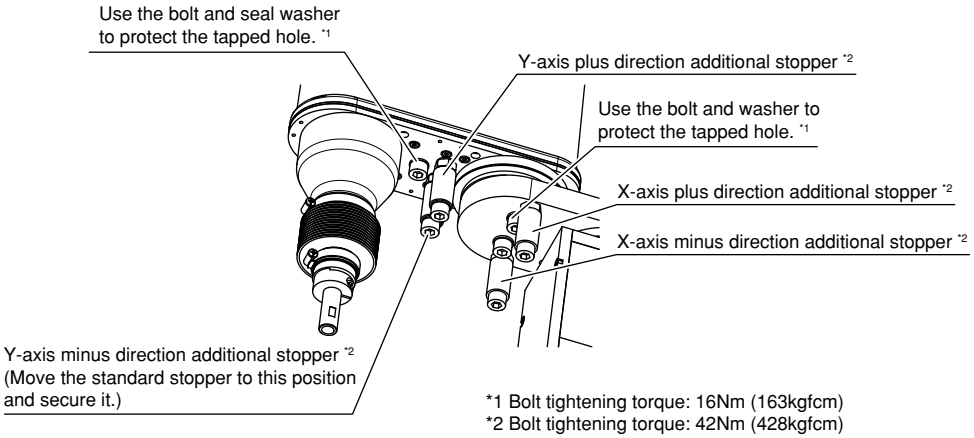
NOTE

The X-axis may not stop at a position before the stopper due to the stopper part accuracy or position. If this happens, decrease the value while referring to the Table "■ Soft limits" described previously.

■ Installing the additional stoppers in both the plus and minus directions

Install the additional stoppers in both the plus and minus directions while referring to the Fig. below.

Installing the additional stoppers in both the plus and minus directions


Use the bolt and seal washer to protect the tapped hole. *1
Y-axis plus direction additional stopper *2
Use the bolt and washer to protect the tapped hole. *1
X-axis plus direction additional stopper *2
X-axis minus direction additional stopper *2
Y-axis minus direction additional stopper *2 (Move the standard stopper to this position and secure it.)
*1 Bolt tightening torque: 16Nm (163kgfcm)
*2 Bolt tightening torque: 42Nm (428kgfcm)

23214-HM-00

5. Limiting the movement range with Z-axis mechanical stopper

The Z-axis additional mechanical stopper cannot be installed in the YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), and YK600XGLC(P) as they are equipped with bellows.

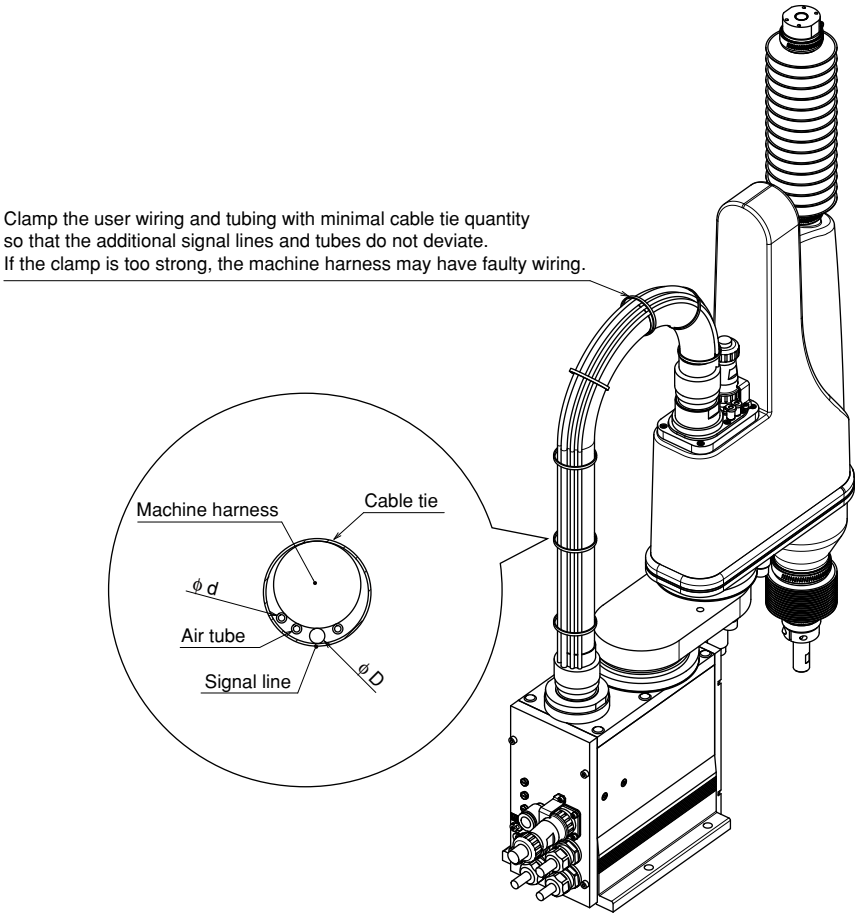
6. Working envelope and mechanical stopper positions for maximum working envelope

Working envelope of each robot and mechanical stopper positions for the maximum working envelope are shown in "1.2 External view and dimensions" in Chapter 5.
For details about cautions, see the Installation Manual for YK-XG standard models.
For the YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), and YK600XGLC(P), operate the robot carefully since there are positions where the base flange or robot cable interferes with the spline, bellows, or tool flange even within the working envelope.

7. Installing the user wiring and tubing newly

Use the user wiring and tubing in the machine harness as much as possible by considering the durability of the machine harness.
If the user wiring and tubing incorporated into the machine are insufficient, add new user wiring and tubing using cable ties.
The following shows the outside diameters and quantities that can be added by considering the durability of the machine harness.

Installing the user wiring and tubing newly


Clamp the user wiring and tubing with minimal cable tie quantity
so that the additional signal lines and tubes do not deviate.
If the clamp is too strong, the machine harness may have faulty wiring.
Machine harness
Cable tie
ϕ d
Air tube
Signal line
ϕ D

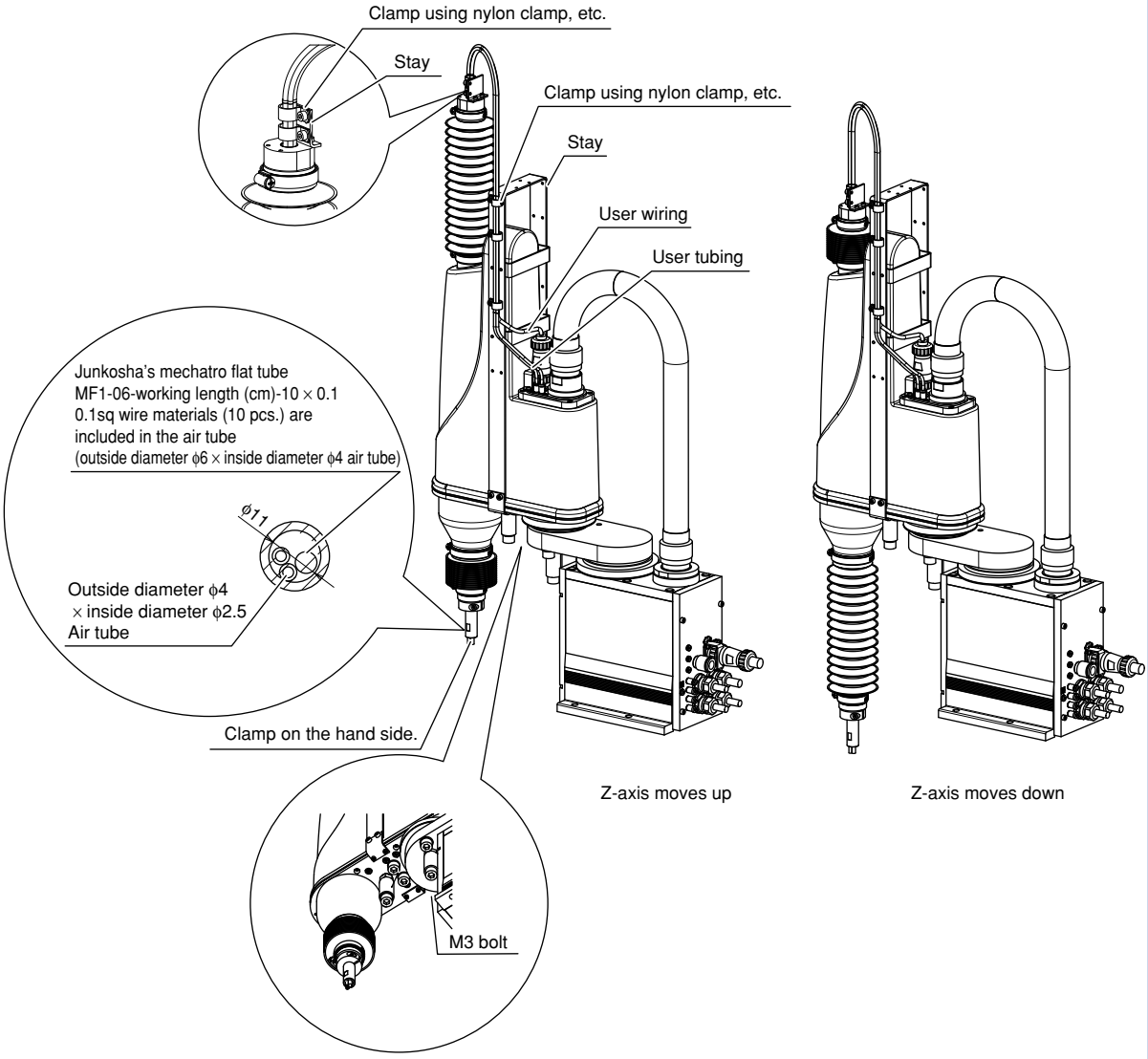
23215-HM-00

Robot model	Signal line outside diameter ϕ D (mm) × quantity	Tube outside diameter ϕ d (mm) × quantity
YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), YK600XGLC(P)	ϕ6 × 1 pc.	ϕ4 × 3 pcs.

8. Passing the user wiring and tubing through the spline

In the YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), and YK600XGLC(P), the user wiring and tubing can be passed through the spline.
The following Fig. shows a reference example.
The wiring at the top end of the spline can be detached or attached easily when replacing the spline, R-axis speed reduction unit, or R-axis motor. Use an appropriate connector that passes through the spline with an inside diameter of ϕ11.

Example of how to pass the wiring and tubing



23216-HM-00

9. Detaching or attaching the covers

To detach the covers, remove the bolts and screws.
It is recommended to replace the O-rings and seals shown below with new ones.

No.	Part name	Part number	Q'ty
1	O-ring	90200-01J350	2
2	O-ring	90990-17J025	1
3	Seal washer	90990-36J008	4
4	Seal	KDM-M1328-000	1
5	Seal	KDM-M1329-000	1
6	Seal	KDM-M1567-000 (YK250XGC(P), YK350XGC(P), YK400XGC(P))	1
		KDM-M1567-100 (YK500XGLC(P), YK600XGLC(P))	
7	Seal	KDM-M1568-000 (YK250XGC(P), YK350XGC(P), YK400XGC(P))	1
		KDM-M1568-100 (YK500XGLC(P), YK600XGLC(P))	
8	Seal washer	90990-36J008	4
9	Seal	KDM-M1315-000	2

⚠WARNING

WHEN THE COVERS HAVE BEEN REMOVED FOR THE MAINTENANCE WORK, BE SURE TO RETURN THE COVERS TO THEIR ORIGINAL POSITIONS USING THE SCREWS AND BOLTS THAT HAVE SECURED THEM. IF ANY SCREW IS LOST, BE SURE TO SECURE THE COVERS USING THE SPECIFIED SCREWS AND QUANTITIES WHILE REFERRING TO THE FIG. BELOW.
IF THE COVERS ARE NOT SECURED FIRMLY, NOISE MAY OCCUR, THE COVER MAY DROP AND FLY OUT, YOUR HAND MAY BE ENTANGLED IN THE DRIVE UNIT DURING TEACHING, OR YOUR HAND MAY BE IN CONTACT THE HOT DRIVE UNIT, CAUSING BURN. TO PREVENT SUCH TROUBLES, STRICTLY OBSERVE THIS INSTRUCTION.

⚠CAUTION

- **The Y-axis arm cover cannot be detached or attached unless the Z-axis is moved down to its lower end.**
- **If any seal loses its strength when detaching the cover, it is recommended to replace it with a new one. If not replaced with a new one, the dust/drip proof performance or the degree of cleanliness may lower.**
- **Some seals are affixed. When removing such seal, peel off the adhesive agent and replace the seal with a new one.**

■ Y-axis arm cover

Step 1 *Turn on the controller.*

Check that no one is inside the safety enclosure, and then turn on the controller.

Step 2 *Press the emergency stop button.*

Press the emergency stop button on the RPB to put the robot in the emergency stop status.

Step 3 *Place a sign indicating the robot is being adjusted.*

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 4 *Enter the safety enclosure while holding the RPB.*

Step 5 ***Disconnect the user wiring and tubing from the spline.***

Disconnect all of the user wiring and tubing that have passed through the spline from the spline.

23217-HM-00

Step 6 ***Loosen the screw of the clamp.***

Step 7 ***Remove the bellows and remove the O-ring.***

23218-HM-00

Step 8 ***Remove the rolling mechanism part and O-ring.***

23219-HM-00

Step 9 ***To prevent the Z-axis from dropping, be sure to prop the spline or end effector with a support stand.***

Step 10 ***Release the Z-axis brake.***

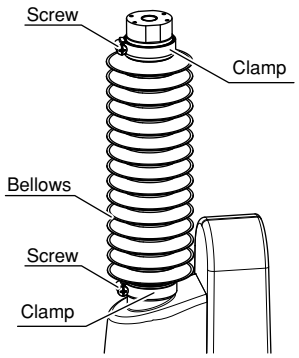
Make sure that dropping of the Z-axis is prevented. Then, carefully move down the Z-axis to a position close to the lower end of the Z-axis.

23220-HM-00

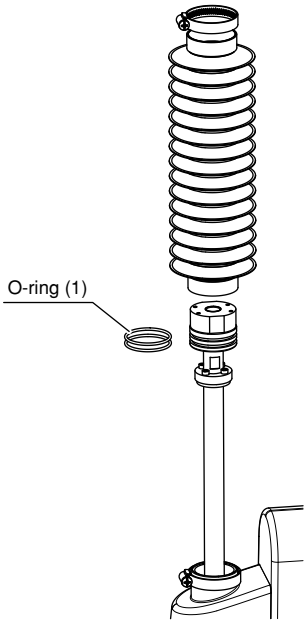
NOTE

For details about how to release the Z-axis brake, see the "YAMAHA Robot Controller User's Manual".

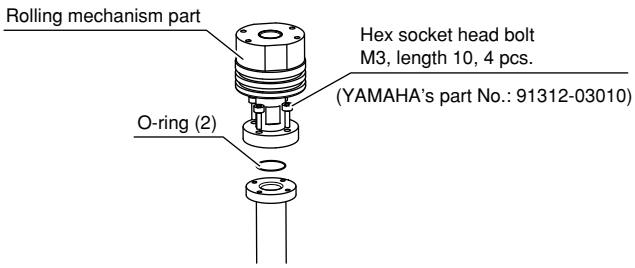
Step 5-6 Disconnecting the user wiring and tubing



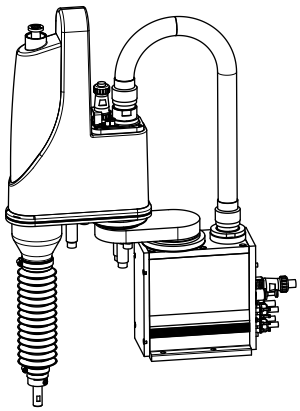
Step 7 Removing the bellows.



Step 8 Removing the rolling mechanism part



Step 10 Releasing the Z-axis brake



Step 11 *Turn off the controller.*

Step 12 *Remove the mounting bracket, disconnect the connector for the user wiring, and remove the plate, seal (4)(5), and seal washer (3).*

23221-HM-00

Step 13 *Remove the cover, seal (6), and seal (7).*

Since the seal (7) is affixed to the Y-axis arm, peel off the adhesive agent completely.

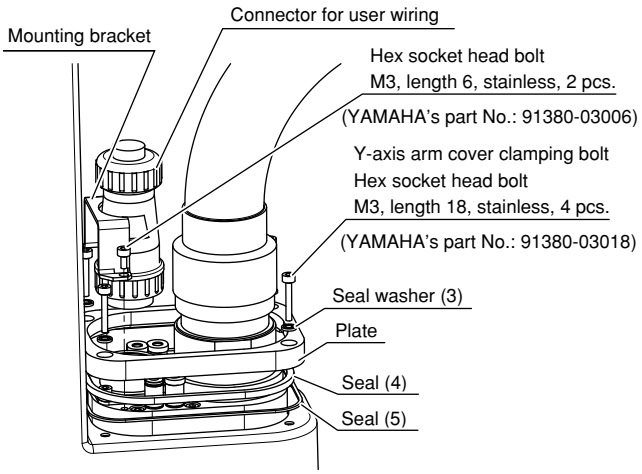
23222-HM-00

23223-HM-00

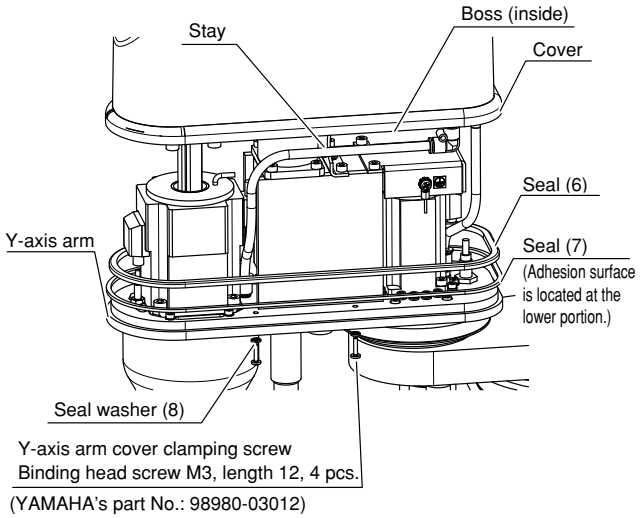
⚠CAUTION

When detaching or attaching the cover, it may be in contact with the boss inside the cover or the stay. So, install the cover while widening it slightly or shifting it.

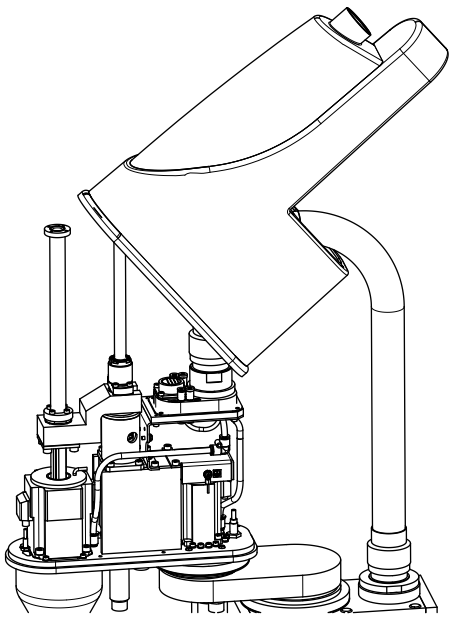
Step 12 Disconnecting the connector for the user wiring and removing the plate, seal, and seal washer



Step 13 Removing the cover and seal



Step 13 Cautions on detaching or attaching the covers



Step 14 ***Place the cover on the base side.***

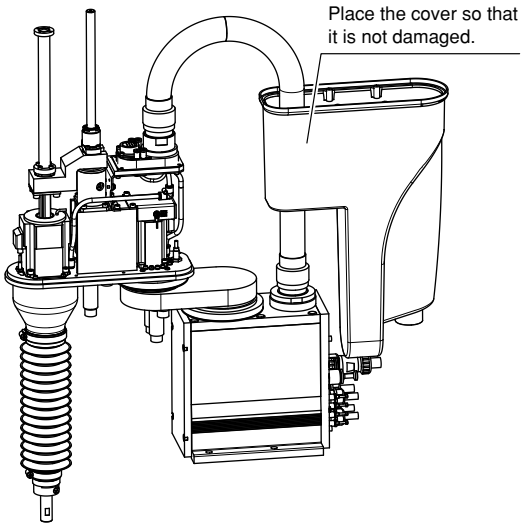
23224-HM-00

Step 15 ***Reattach the cover in the reverse order of detachment.***

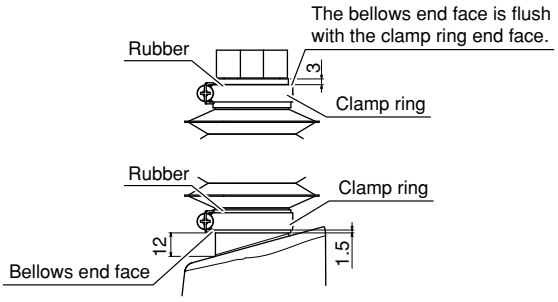
It is recommended to replace the O-rings and seals with new ones. If these parts are not replaced or reattached, the dust/drip proof performance or the degree of cleanliness may lower.
For details about the bellows clamp position, see the Fig. on the right.

23225-HM-00

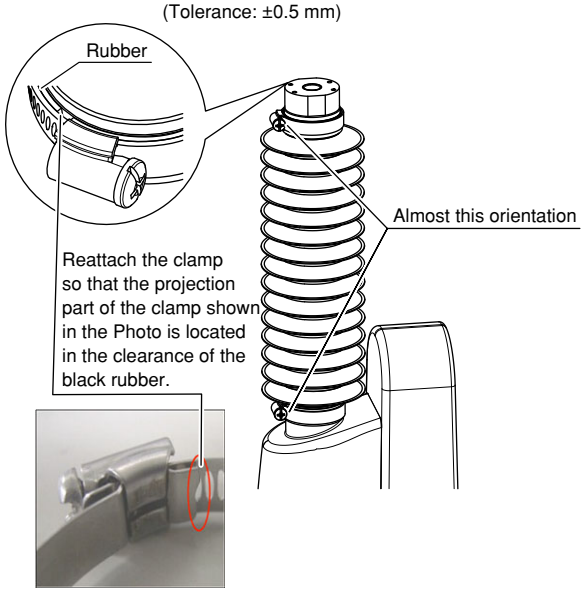
Step 14 Placing the cover



Step 15 Clamp



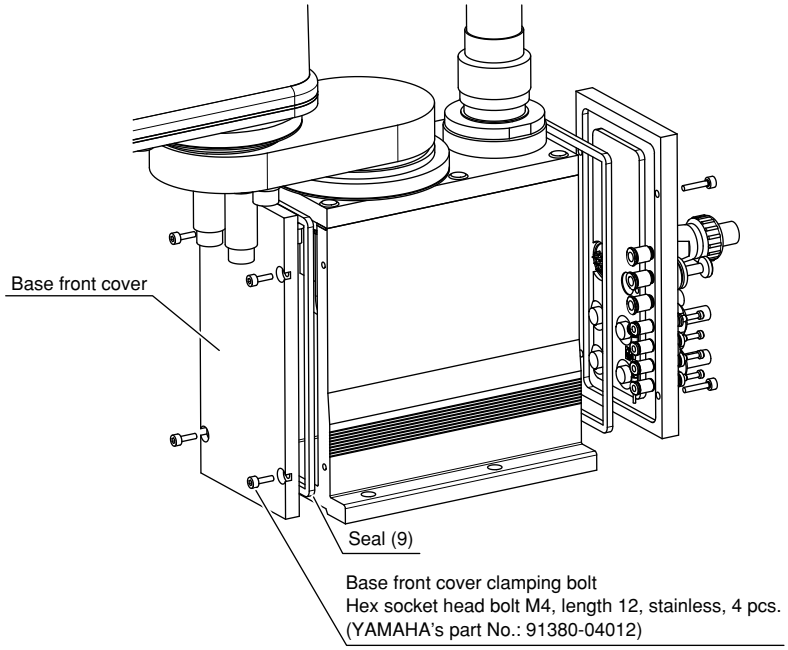
* Install the bellows and clamp at the positions shown in the Fig. above.
(Tolerance: ±0.5 mm)


Rubber
Almost this orientation
Reattach the clamp so that the projection part of the clamp shown in the Photo is located in the clearance of the black rubber.

Base cover

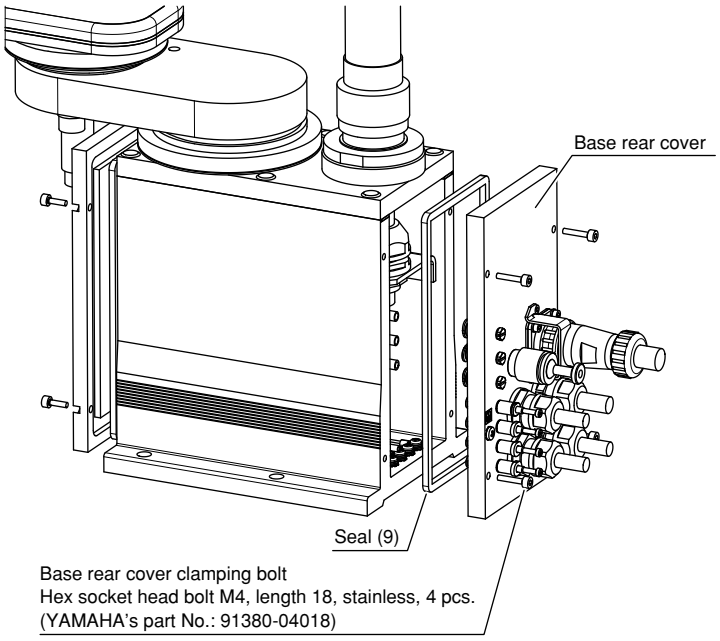
It is recommended to replace the seals with new ones. If these parts are not replaced or reattached, the dust/drip proof performance or the degree of cleanliness may lower.

Removing the base front cover


Base front cover
Seal (9)
Base front cover clamping bolt
Hex socket head bolt M4, length 12, stainless, 4 pcs.
(YAMAHA's part No.: 91380-04012)

23226-HM-00

Removing the base rear cover


Base rear cover
Seal (9)
Base rear cover clamping bolt
Hex socket head bolt M4, length 18, stainless, 4 pcs.
(YAMAHA's part No.: 91380-04018)

23227-HM-00

10. Installing the tool flange

The tool flange can be retrofitted.
The following option parts are needed.

No.	Part No.	Q'ty	Remarks
1	KCY-M1790-000	1	Tool flange
2	91312-05014	2	Bolt
3	92A08-05308	1	Set screw
4	90K41-001490	1	Warning label

Step 1 ***Turn off the controller.***

Step 2 ***Place a sign indicating the robot is being adjusted.***

Place a sign indicating the robot is being adjusted, to keep others from operating the controller and operation panel.

Step 3 ***Enter the safety enclosure.***

Step 4 ***Install the tool flange.***

Align the orientation of the tapped hole for the tool flange set screw with that of the width across flat part of the spline, and then insert the tool flange all the way inside.

23228-HM-00

Step 5 ***Install the tool flange with the bolt (2).***

Secure the tool flange after it has been inserted all the way inside.

• Tightening torque: 9Nm (92kgfcm)

Apply the grease to the bolt thinly to make the tightening torque stable.

23229-HM-00

Step 6 ***Tighten the set screw (3).***

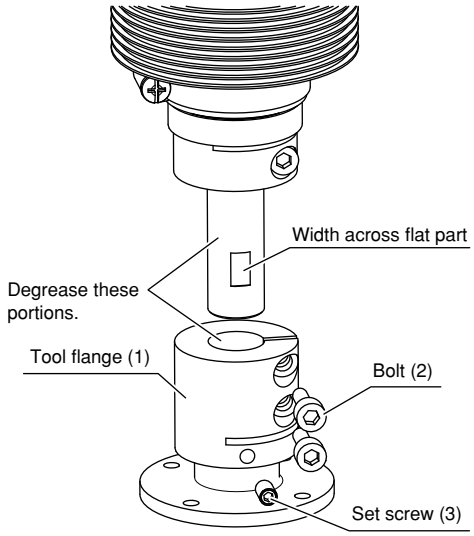
• Tightening torque: 3.5Nm (36kgfcm)

Apply Loctite 262 (Henkel Japan) to the set screw.

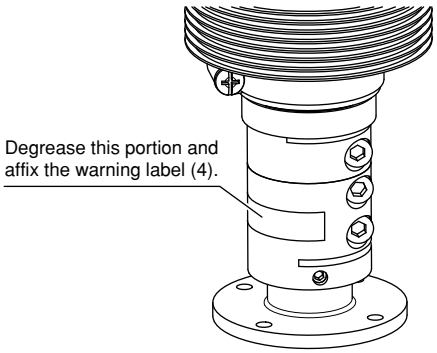
Step 7 ***Affix the warning label (4).***

Step 8 ***Go out of the safety enclosure.***

Step 4-6 Installing the tool flange



Step 7 Installing the tool flange



Chapter 3 Robot settings

Contents

1. Overview 3-1
2. Adjusting the origin 3-2
3. Standard coordinate setting using a standard coordinate setup jig 3-3

1. Overview

Various settings have been completely made at the factory or by your distributor before shipment, including the origin position setting. If the operating conditions are changed and the robot needs to be set again, then follow the procedures described in this chapter.

The following describes the safety precautions to be observed when making various settings.

⚠CAUTION

- **Read and understand the contents of this chapter completely before attempting to set the robot.**
- **Place a conspicuous sign indicating the robot is being adjusted, to prevent others from touching the controller switch, programming box or operation panel.**
- **If a safety enclosure has not yet been provided right after installation of the robot, rope off or chain off the movement area around the manipulator in place of a safety enclosure, and observe the following points.**
  1. **Use stable posts which will not fall over easily.**
  2. **The rope or chain should be easily visible by everyone around the robot.**
  3. **Place a conspicuous sign prohibiting the operator or other personnel from entering the movement area of the manipulator.**
- **To check the operation after the settings have been made, refer to the section "4.5.1 Trial Operation" in Chapter "Safety Instructions" of this manual.**

This Chapter describes only the points that are different from the standard models.
For details about other explanations, see the Installation Manual for YK-XG series standard models.

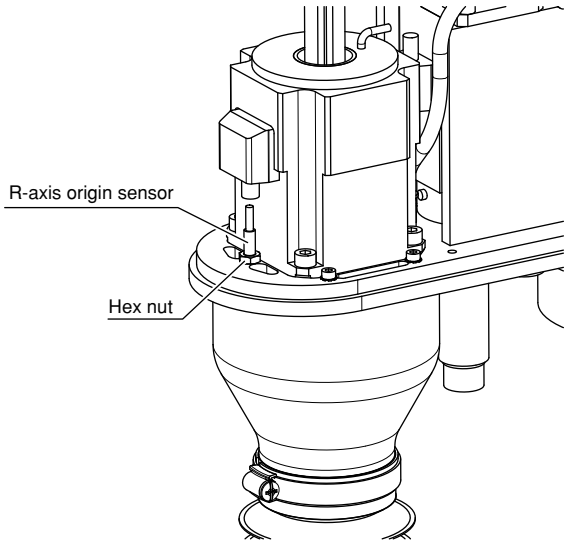
2. Adjusting the origin

This section describes only the origin adjustment points that are different from the standard models.
For details about other explanations, see the Installation Manual for YK-XG series standard models.

■ Adjusting the origin of the YK250XGC(P), YK350XGC(P), YK400XGC(P), YK500XGLC(P), or YK600XGLC(P)

- Since the joints of the X-, Y-, and R-axis are covered, it is difficult to understand the clearance between the sensor and dog. After the return-to-origin has performed in the same manner as the standard model, carefully adjust the machine reference so that the origin does not deviate even when you touch the arm, etc. accidentally during work.
  After the machine reference has been adjusted, turn the joint to check that the sensor does not collide with the dog.
- Since the joints are covered, the origin positions of the X-axis and Y-axis cannot be changed.
- The R-axis sensor uses a compact sensor. So, carefully check that the tightening torque of the hex nut is as small as 1Nm (10kgfcm). If tightened to a torque larger than this level, the sensor may break.

R-axis origin sensor and hex nut



23301-HM-00

3. Standard coordinate setting using a standard coordinate setup jig

Use a standard coordinate setup jig (option) to set the standard coordinates more accurately.
The following describes how to set the standard coordinates using the standard coordinate setup jig.

Standard coordinate setup jig (option)

	Part No.	Name	Q'ty
1	KDM-M1577-000	Pin	1
2	91312-04065	Bolt	1

Step 1 *Turn on the controller.*

Check that no one is inside the safety enclosure, and then turn on the controller.

Step 2 *Put the robot in the emergency stop status.*

Press the emergency stop button on the RPB to put the robot in the emergency stop status.

NOTE

For details about emergency stop and how to cancel the emergency stop, see the "YAMAHA Robot Controller User's Manual".

Step 3 *Place a sign indicating the robot is being adjusted.*

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 4 *Enter the safety enclosure while holding the RPB.*

Step 5 *Remove the plug bolt and seal washer.*

Put the robot in the posture with the positional relationship between the Y-axis arm and the X-axis arm as shown in the Fig. on the right, and then remove the plug bolt and seal washer.

23302-HM-00

Step 6 *Insert the pin (1).*

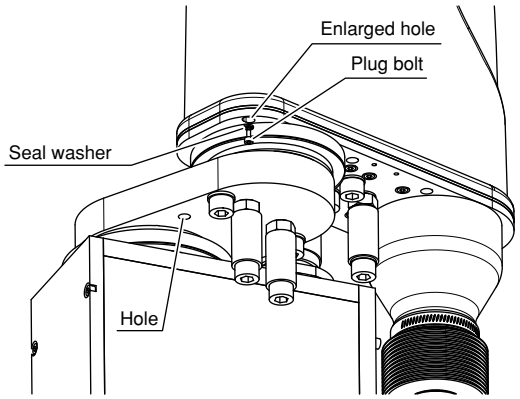
1. Put the robot in the arm posture allowing insertion of the pin, and make the X-axis arm almost aligned with the Y-axis.
2. Adjust the arm positions so that the pin can be inserted into the enlarged hole in the Y-axis arm and the hole in the X-axis arm without jamming, and then insert the pin into the holes.

23303-HM-00

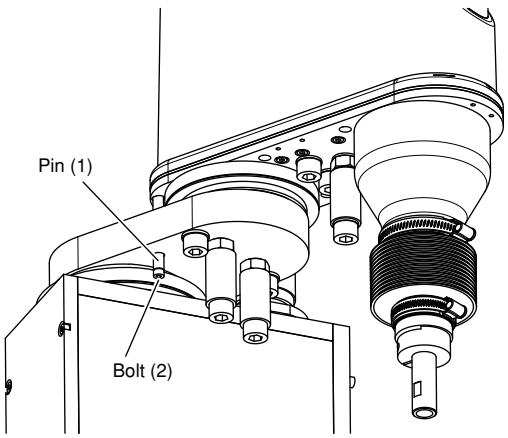
Step 7 *Secure the pin (1) with the bolt (2).*

Lightly tighten the bolt so that the pin does not move.

Step 5 Removing the plug bolt



Step 6-8 Y-axis position pulse value



Step 8 Make a note of the Y-axis position pulse value.

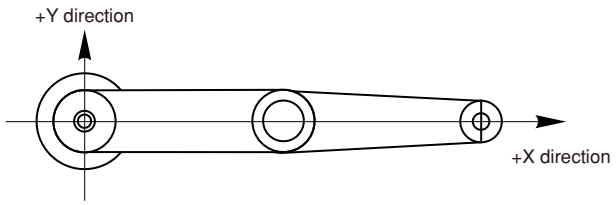
1. Enter "MANUAL>POINT" mode.
2. Lightly apply a clockwise torque to the Y-axis while holding the X-axis arm.
3. Make a note of the Y-axis position pulse value displayed on (POS) when the torque is unloaded.
4. Lightly apply a counterclockwise torque to the Y-axis while holding the X-axis arm.
5. Make a note of the Y-axis position pulse value displayed on (POS) when the torque is unloaded.

Step 9 Determine the + direction of the X-axis.

Move the X-axis arm in the direction that you want to set as the + direction of the X-axis. At this time, make a note of the X-axis position pulse value displayed on (POS).

23303-F6-00

Step 9 X-axis + direction



Step 10 Enter the "11. Arm length [mm]" values.

Enter the following values in M1 and M2 for "11. Arm length (mm)" of axis parameters.

	M1 (X-axis arm length)	M2 (Y-axis arm length)
YK250XGC(P)	100.00	150.00
YK350XGC(P)	200.00	150.00
YK400XGC(P)	250.00	150.00
YK500XGLC(P)	250.00	250.00
YK600XGLC(P)	350.00	250.00

Step 11 Enter the "12. Offset pulse" values.

Enter the values shown on the right in "12. Offset pulse" of axis parameters.

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Step 11 Entering the “12. Offset pulse” values

M1= X-axis position pulse value you have made a note of in step 9

$$M2=\frac{\text{Y-axis position pulse value you have made a note of in step 8 (clockwise)} + \text{Y-axis position pulse value you have made a note of in step 8 (counterclockwise)}}{2}$$

Note) Round off the decimal part of the M2 value.

Step 12 Reattach the plug bolt and seal washer.

1. Remove the pin and bolt.
2. Reattach the plug bolt and seal washer.

Chapter 4 Periodic inspecition

Contents

1. List of inspection items 4-1

1. List of inspection items

⚠WARNING

ONLY QUALIFIED ENGINEERS WHO HAVE RECEIVED THE ROBOT TRAINING COURSE CONDUCTED BY YOUR DISTRIBUTOR ARE ALLOWED TO INSPECT THE ITEMS NEEDING THE COVER REMOVAL WORK WHILE REFERRING TO THE SEPARATE MAINTENANCE MANUAL FOR YK-XG SERIES.

●: Conduct. ○: Conduct if trouble is found as a result of inspection. △: Contact your distributor.

Location	Contents	Daily	6-month	Cleaning	Adjustment	Replacement
■ Inspection with the controller turned off						
Machine harness Robot cable	• Check for scratch, dent, or excessive bend.	●			○	
	• Check for damage.	●				△
Bellows	• Check for breakage.		●			○
Cables prepared by user	• Check for scratch, dent, or excessive bend.	●			○	○
Regulator Joint Air tube Solenoid valve Air cylinder	• Check that the air pressure level is correct.	●			○	
	• Check for air leak.	●			○	
	• Check that the drain is discharged.	●			○	
	• Check the air filter for contamination or damage.	●		○		○
Exterior of robot	• Check for damage.	●				△
Major bolts and screws of robot main body (those exposed to the outside)	• Check for looseness. (*1)		●		○	
Controller	• Check the terminal on the outside of the controller for looseness.		●		○	
	• Check the connection connector for looseness. (*2)		●		○	
Application of grease to Z-axis spline and Z-axis ball screw (*3)	• Remove the old grease with a cloth rag and apply the grease. YK-XG(L)C: LG2(NSK) YK-XG(L)P: Alvania grease S2 (Showa Shell)		●			
Z-axis ball screw and ball spline	• Check for play.		●		○	△
■ Inspection with the controller turned on						
Safeguard enclosure	• Check that the safeguard enclosure is located at its specified position.	●			○	
	• Check that the emergency stop turns on when the safeguard enclosure is open.	●			○	
	• Check that the warning label is affixed to the entrance.	●			○	
Emergency stop switch	• Check that the emergency stop turns on when pressed.	●			○	
Robot operation	• Check for unusual operation, vibration, or noise.	●			△	
Functional check of Z-axis brake (*4)	• Drop amount from the Z-axis rest state is 3mm or less.	●			△	
Air cooling fan on the rear of the controller	• Check that the fan rotates.		●		○	
	• Check for object blocking the fan.		●		○	
	• Check for noise during rotation. (*5)		●		○	△
	• Check the fan cover for contamination.		●	○		△

*1: If any bolt or screw is loose, retighten it. (For details about tightening torque, see the table below.)

*2: For details, see "4. Robot cable connection" in Chapter 2.

*3: For detail about how to apply the grease, see the separate Maintenance Manual.

*4: When the emergency stop switch is pressed outside the safeguard enclosure or when the controller power is turned off, visually inspect the Z-axis brake.

*5: If any object is found through the visual inspection, remove it. If noise is heard even when no object is found, contact your distributor.

Bolt tightening torque

Bolt size	Tightening torque (kgfcm)	Tightening torque (Nm)
M3 button head bolt	14	1.4
M4 set screw	20	2.0
M3	20	2.0
M4	46	4.5
M5	92	9.0
M6	156	15.3
M8	380	37
M10	459	45.0
M12	1310	128
M14	2090	205

Chapter 5 Specifications

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1.2.2 YK350XGC(P) 5-4
1.2.3 YK400XGC(P) 5-6
1.2.4 YK500XGLC(P) 5-8
1.2.5 YK600XGLC(P) 5-10

1. Manipulator

1.1 Basic specification

Robot model			YK250XGC(P)	YK350XGC(P)	YK400XGC(P)	YK500XGLC(P)	YK600XGLC(P)
Axis specifications	X-axis	Arm length	100mm	200mm	250mm	250mm	350mm
		Rotation angle	±129°				
	Y-axis	Arm length	150mm			250mm	
		Rotation angle	±134°		±144°		
	Z-axis	Stroke	150mm				
	R-axis	Rotation angle	±360°				
Motor		X-axis	200W				
		Y-axis	150W				
		Z-axis	50W				
		R-axis	100W				
Maximum speed		XY resultant	4.5m/s	5.6m/s	6.1m/s	5.1m/s	4.9m/s
		Z-axis	1.1m/s				
		R-axis	1020°/s				
Repeatability (*1)		XY-axes	±0.01mm				
		Z-axis	±0.01mm				
		R-axis	±0.004°				
Payload			4kg				
R-axis tolerable moment of inertia (*2)			0.05kgm^2 (0.5kgfcms^2)				
User wiring			10 cables				
User tubing			ϕ4×4				
Travel limit			1.Soft limit 2.Mechanical stopper (XYZ-axes)				
Robot cable			3.5m (option: 5m, 10m)				
Weight			21.5kg	22kg	22.5kg	25kg	26kg
Degree of cleanliness (YK-XG(L)C)			Class ISO 3 (ISO14644-1), Suction air flow 30Nℓ/min. (*3)				
Dust/drip proof protection rating (YK-XG(L)P)			IP65 (IEC60529) or its equivalent (*4)				

*1: At constant ambient temperature (XY)
*2: There are limits to acceleration coefficient settings.
*3: Class 10 (0.1μm) FED-STD-209D or its equivalent
The required suction air flow may vary depending on the operating conditions or environment.
*4: Do not splash the jet flow onto the bellows directly.
For details about drip proof performance for fluid other than water, contact your distributor.

* The Z-axis spline may vibrate in a Z-axis operation speed range of 20% to 40% depending on the arm position or Z-axis position. If the Z-axis spline vibrates, operate it beyond this operation speed range.

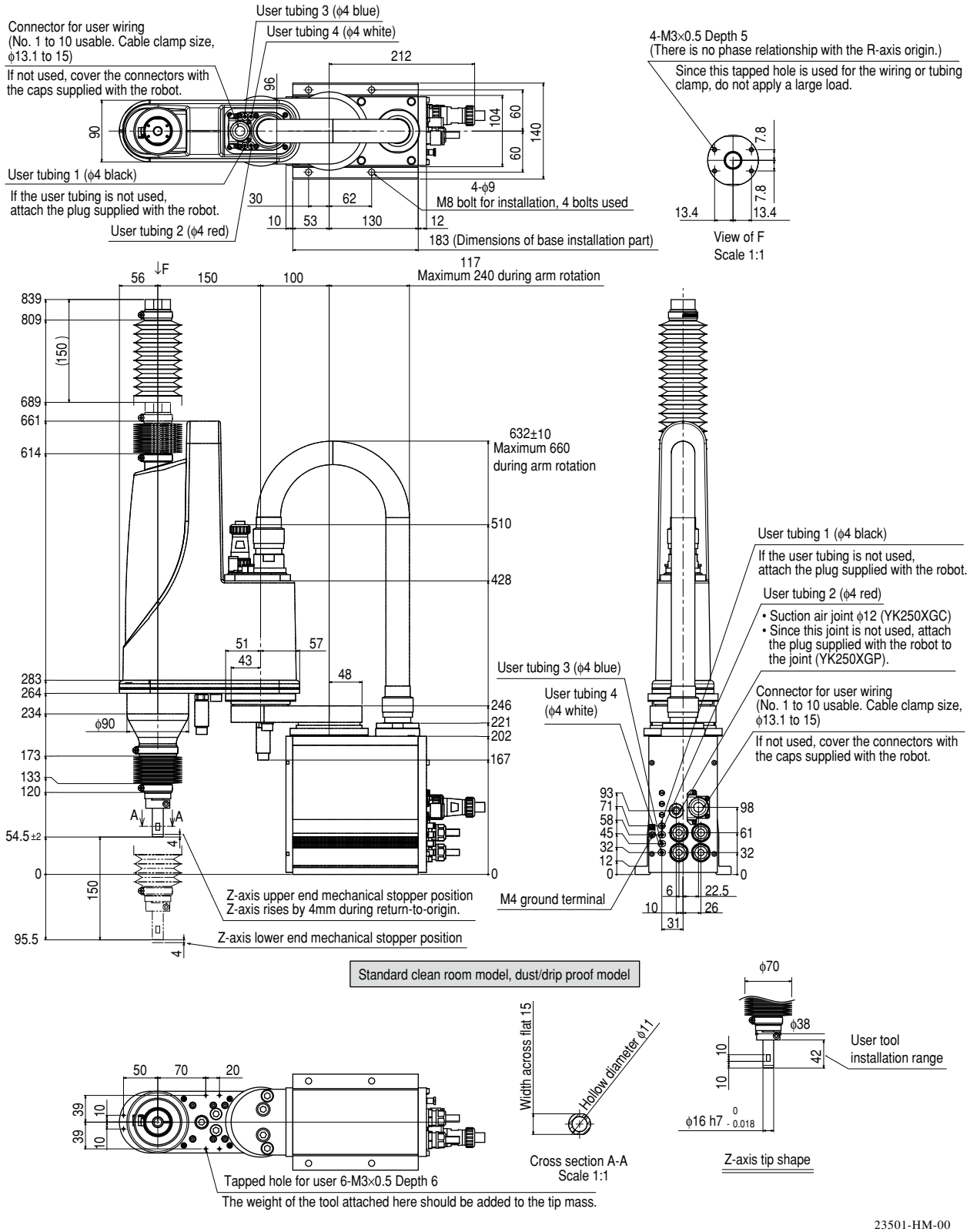
Noise level

Equivalent sound level of robot, Laeq (A) (when there is 10dB or larger difference from the back ground sound pressure level)	Position where the noise level is measured
75.1dB	1.25m apart from the back of the robot, 1.6m height from the floor surface.

Note: The noise level can be higher when the robot is set nearby the objects that cause sound reflection.

1.2 External view and dimensions

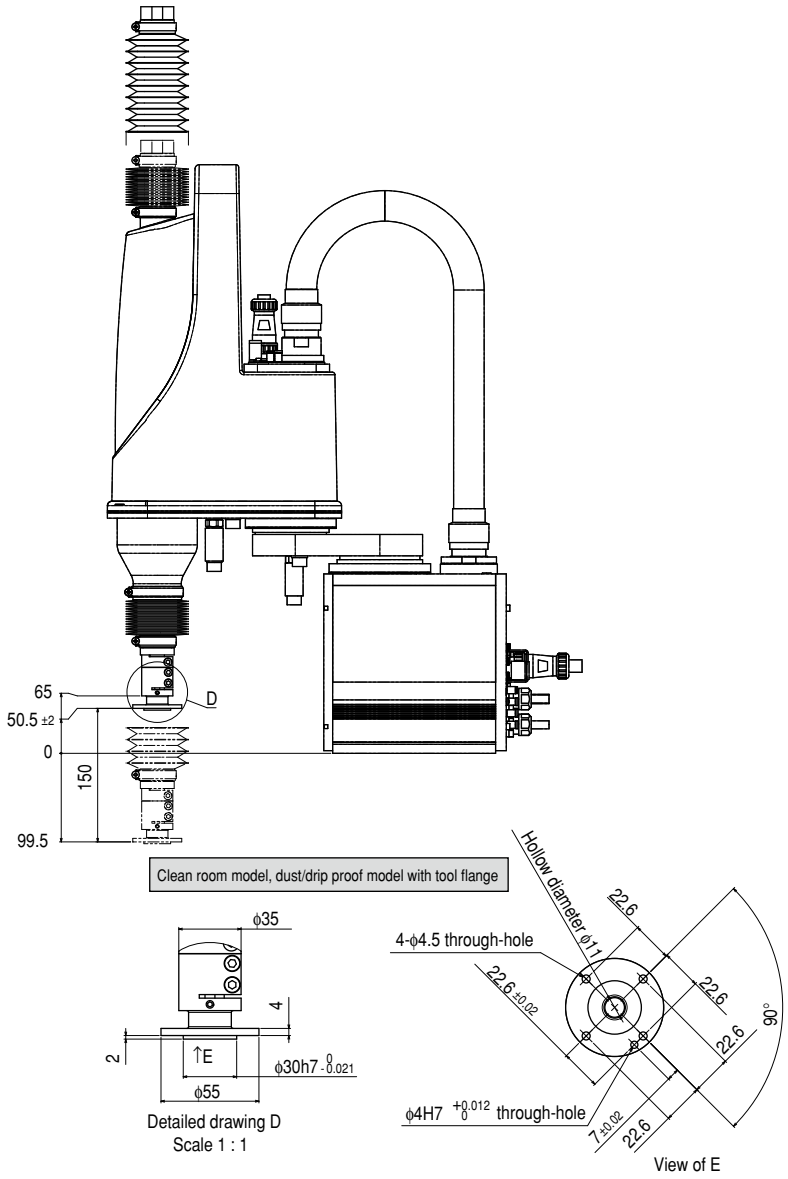
1.2.1 YK250XGC(P)


Connector for user wiring
(No. 1 to 10 usable. Cable clamp size, ϕ13.1 to 15)
If not used, cover the connectors with the caps supplied with the robot.
User tubing 3 (ϕ4 blue)
User tubing 4 (ϕ4 white)
User tubing 1 (ϕ4 black)
If the user tubing is not used, attach the plug supplied with the robot.
User tubing 2 (ϕ4 red)
4-ϕ9
M8 bolt for installation, 4 bolts used
183 (Dimensions of base installation part)
117
4-M3×0.5 Depth 5
(There is no phase relationship with the R-axis origin.)
Since this tapped hole is used for the wiring or tubing clamp, do not apply a large load.
View of F
Scale 1:1
Maximum 240 during arm rotation
632±10
Maximum 660 during arm rotation
Z-axis upper end mechanical stopper position
Z-axis rises by 4mm during return-to-origin.
Z-axis lower end mechanical stopper position
M4 ground terminal
Standard clean room model, dust/drip proof model
Tapped hole for user 6-M3×0.5 Depth 6
The weight of the tool attached here should be added to the tip mass.
Width across flat 15
Hollow diameter ϕ11
Cross section A-A
Scale 1:1
ϕ70
ϕ38
User tool installation range
ϕ16 h7 0 -0.018
Z-axis tip shape

23501-HM-00

YK250XGC, YK250XGP

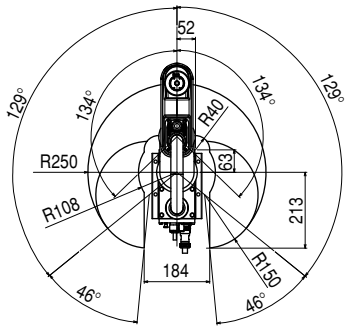
Tool flange mount type



23502-HM-00

YK250XGC, YK250XGP

Working envelope



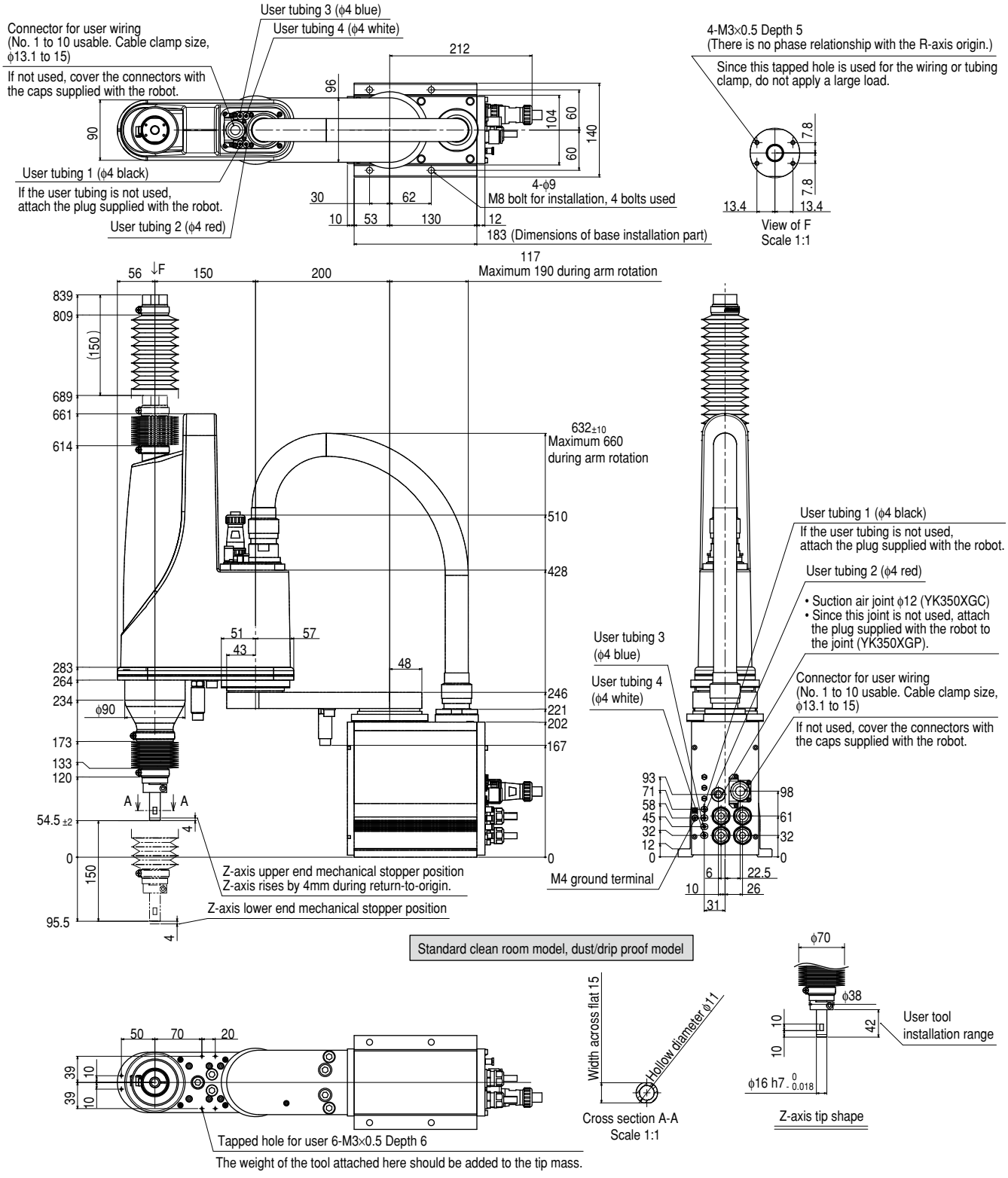
Option :
- X-axis additional stopper: X-axis mechanical stopper position can be changed to 119°-position (working envelope, 117°).
- Y-axis additional stopper: Y-axis mechanical stopper position can be changed to 108°-position (working envelope, 106°).

Other option: Standard coordinate setting jig

- Note that the robot cannot be used at a position where the base flange, robot cable, spline, bellows, and tool flange interfere with each other in the working envelope shown above.
- X-axis mechanical stopper position : 131°
- Y-axis mechanical stopper position : 136°

23503-HM-00

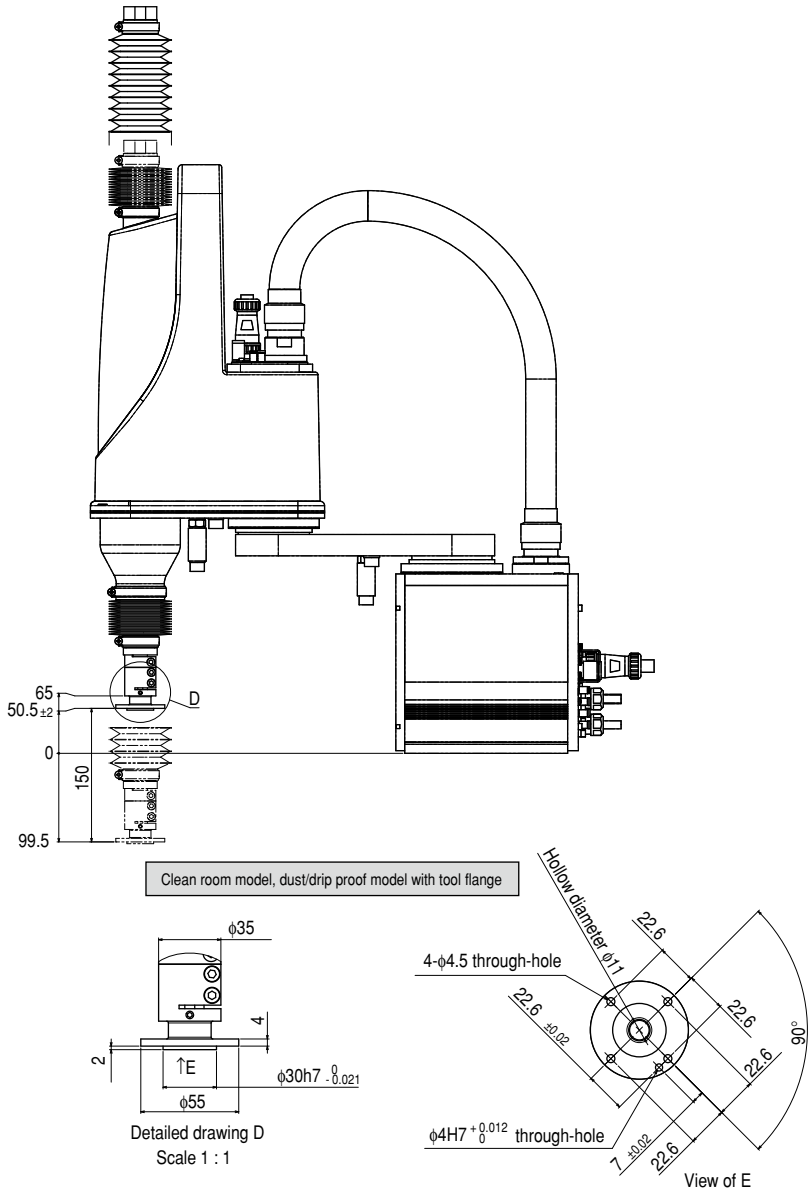
1.2.2 YK350XGC(P)



23504-HM-00

YK350XGC, YK350XGP

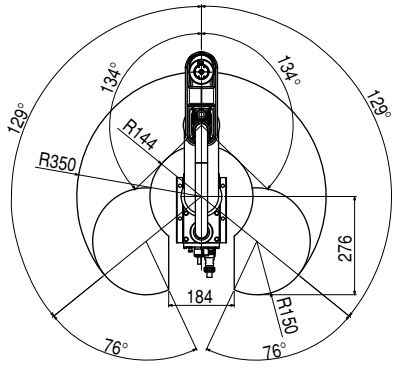
Tool flange mount type



23502-HM-00

YK350XGC, YK350XGP

Working envelope



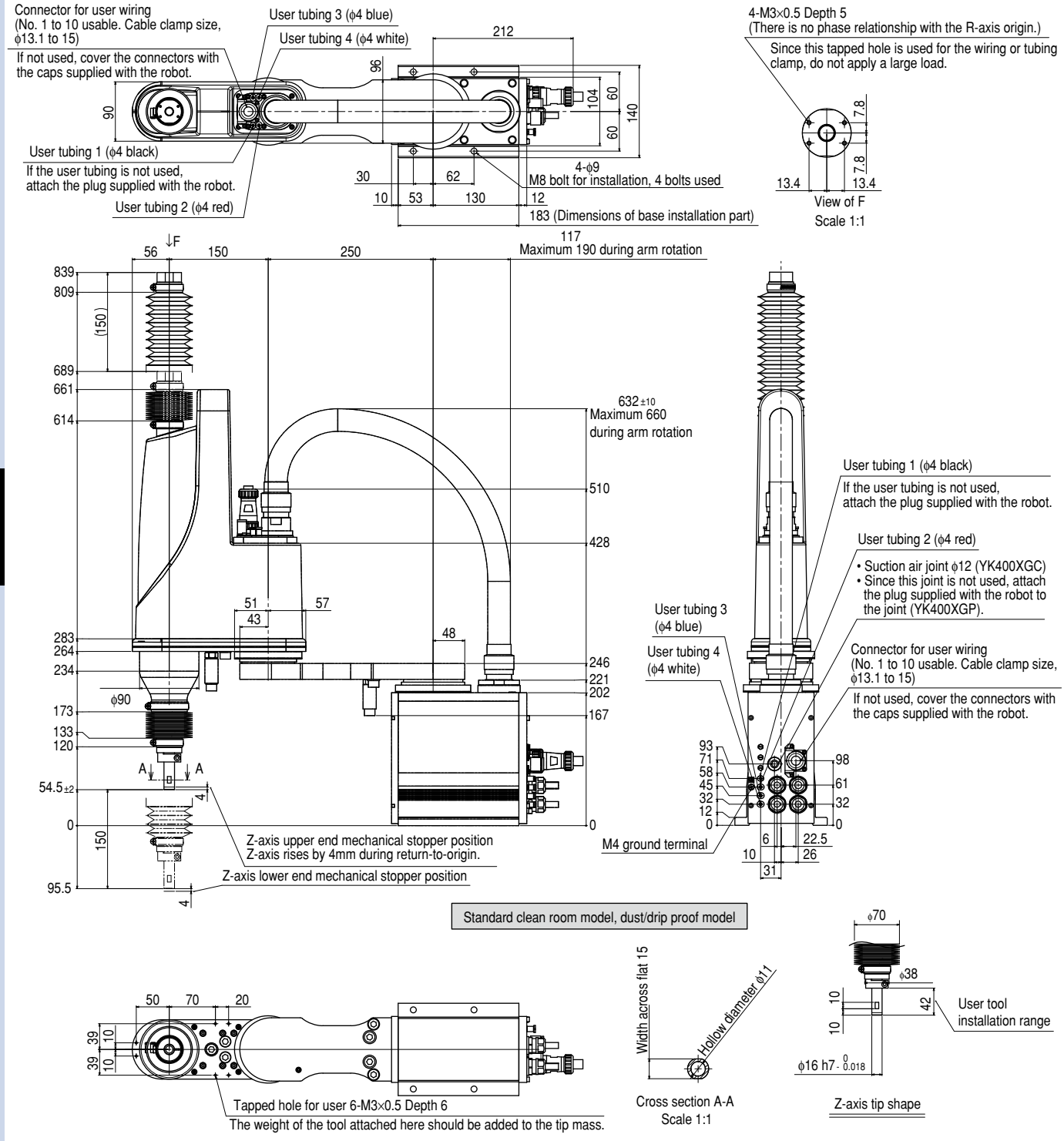
Option :
- X-axis additional stopper: X-axis mechanical stopper position can be changed to 119°-position (working envelope, 117°).
- Y-axis additional stopper: Y-axis mechanical stopper position can be changed to 108°-position (working envelope, 106°).

Other option: Standard coordinate setting jig

- Note that the robot cannot be used at a position where the base flange, robot cable, spline, bellows, and tool flange interfere with each other in the working envelope shown above.
- X-axis mechanical stopper position : 131°
- Y-axis mechanical stopper position : 136°

23506-HM-00

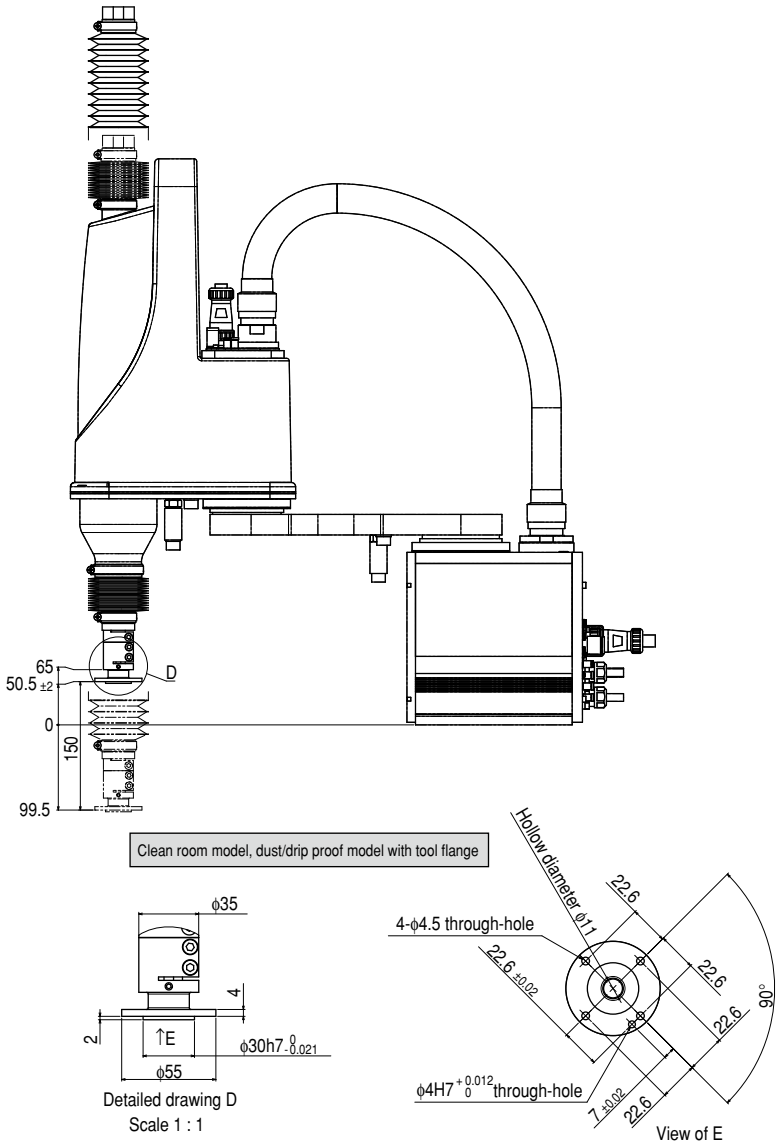
1.2.3 YK400XGC(P)



23507-HM-00

YK400XGC, YK400XGP

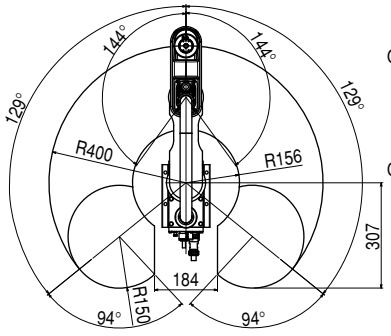
Tool flange mount type



23508-HM-00

YK400XGC, YK400XGP

Working envelope



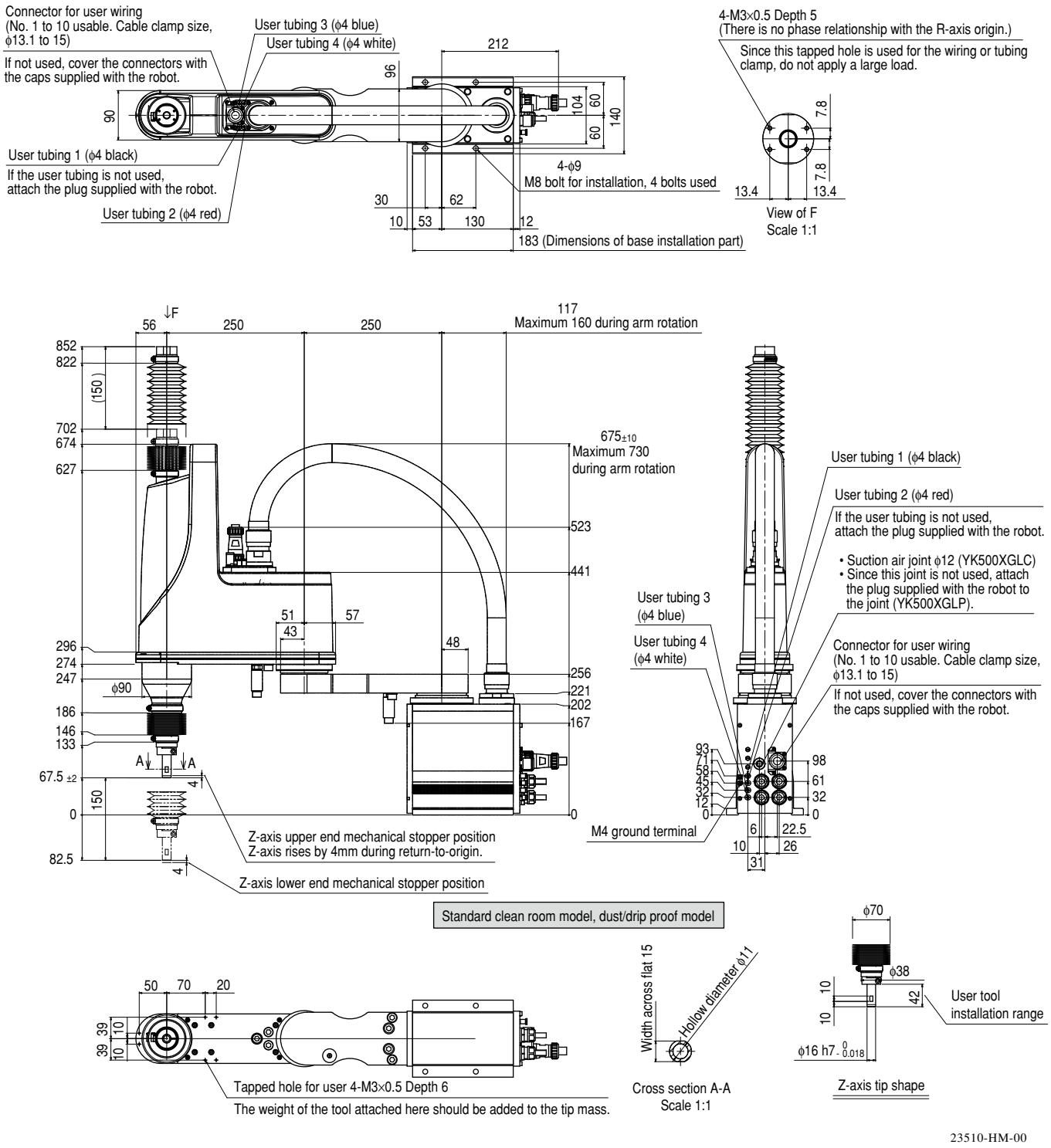
Option :
- X-axis additional stopper: X-axis mechanical stopper position can be changed to 119°-position (working envelope, 117°).
- Y-axis additional stopper: Y-axis mechanical stopper position can be changed to 108°-position (working envelope, 116°).

Other option: Standard coordinate setting jig

- Note that the robot cannot be used at a position where the base flange, robot cable, spline, bellows, and tool flange interfere with each other in the working envelope shown above.
- X-axis mechanical stopper position : 131°
- Y-axis mechanical stopper position : 146°

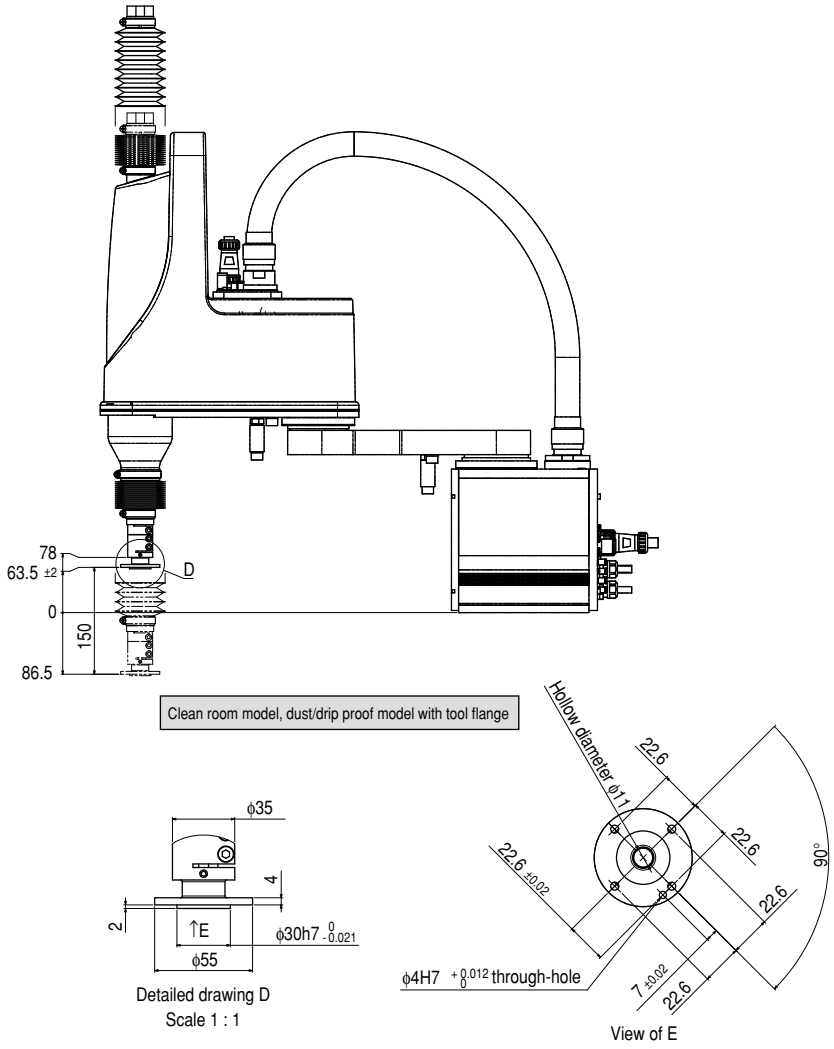
23509-HM-00

1.2.4 YK500XGLC(P)


Connector for user wiring
(No. 1 to 10 usable. Cable clamp size, ϕ13.1 to 15)
If not used, cover the connectors with the caps supplied with the robot.
User tubing 3 (ϕ4 blue)
User tubing 4 (ϕ4 white)
User tubing 1 (ϕ4 black)
If the user tubing is not used, attach the plug supplied with the robot.
User tubing 2 (ϕ4 red)
4-M3×0.5 Depth 5
(There is no phase relationship with the R-axis origin.)
Since this tapped hole is used for the wiring or tubing clamp, do not apply a large load.
4-ϕ9
M8 bolt for installation, 4 bolts used
183 (Dimensions of base installation part)
View of F
Scale 1:1
117
Maximum 160 during arm rotation
675±10
Maximum 730
during arm rotation
Z-axis upper end mechanical stopper position
Z-axis rises by 4mm during return-to-origin.
Z-axis lower end mechanical stopper position
M4 ground terminal
Standard clean room model, dust/drip proof model
Tapped hole for user 4-M3×0.5 Depth 6
The weight of the tool attached here should be added to the tip mass.
Width across flat 15
Hollow diameter ϕ11
Cross section A-A
Scale 1:1
User tool installation range
Z-axis tip shape
23510-HM-00

YK500XGLC, YK500XGLP

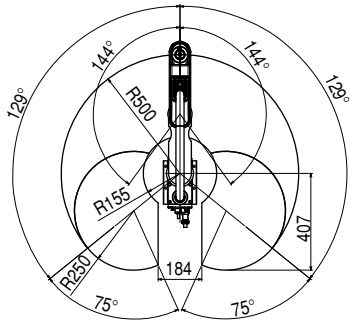
Tool flange mount type



23511-HM-00

YK500XGLC, YK500XGLP

Working envelope



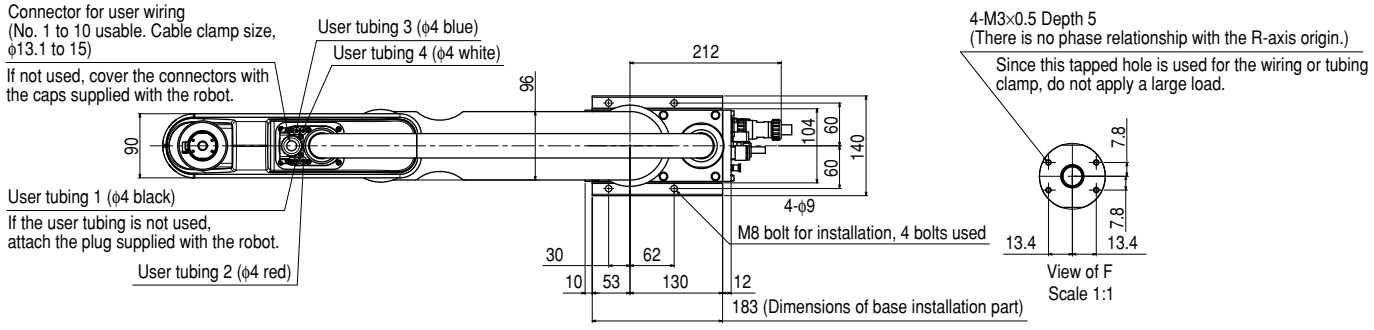
Option :
- X-axis additional stopper: X-axis mechanical stopper position can be changed to 119°-position (working envelope, 117°).
- Y-axis additional stopper: Y-axis mechanical stopper position can be changed to 108°-position (working envelope, 116°).

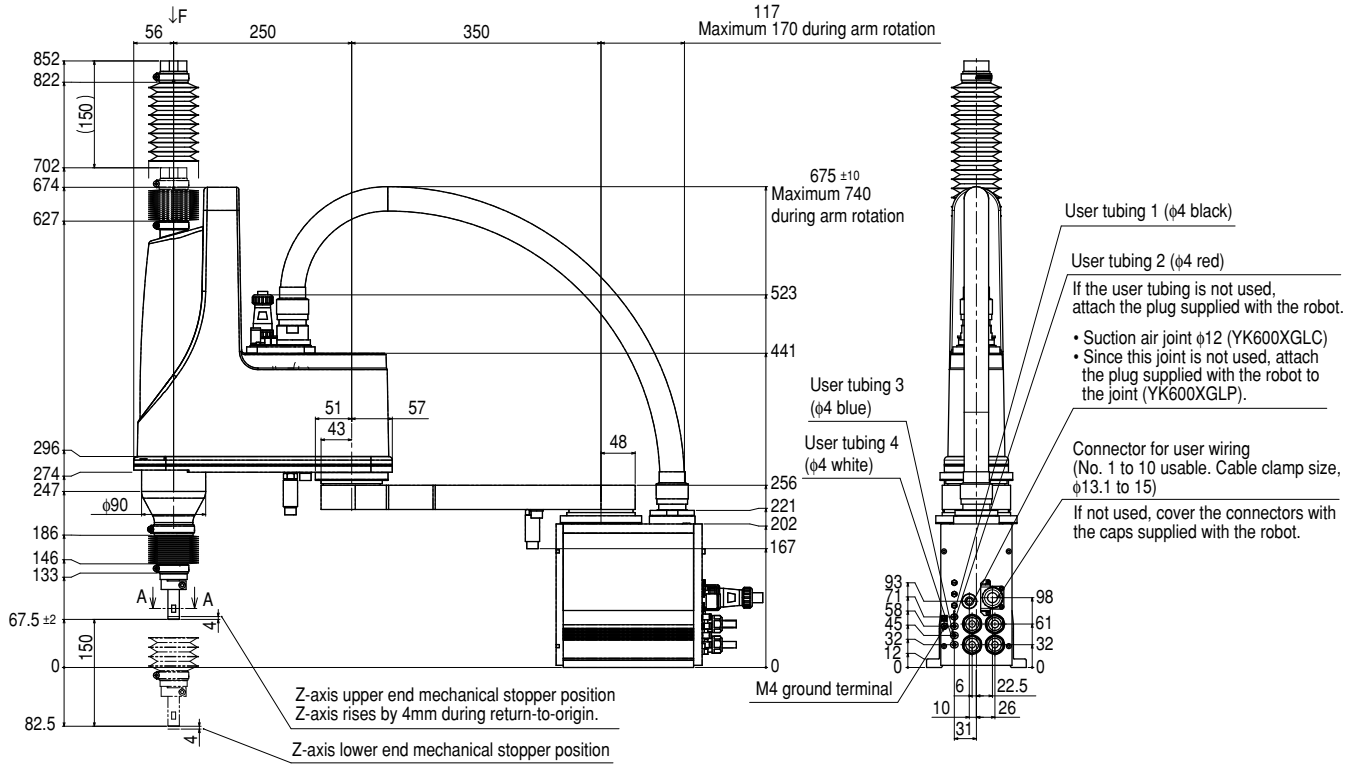
Other option: Standard coordinate setting jig

- Note that the robot cannot be used at a position where the base flange, robot cable, spline, bellows, and tool flange interfere with each other in the working envelope shown above.
- X-axis mechanical stopper position : 131°
- Y-axis mechanical stopper position : 146°

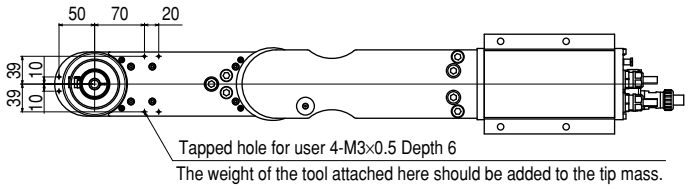
23512-HM-00

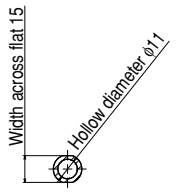
1.2.5 YK600XGLC(P)

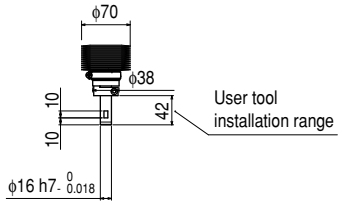




Standard clean room model, dust/drip proof model



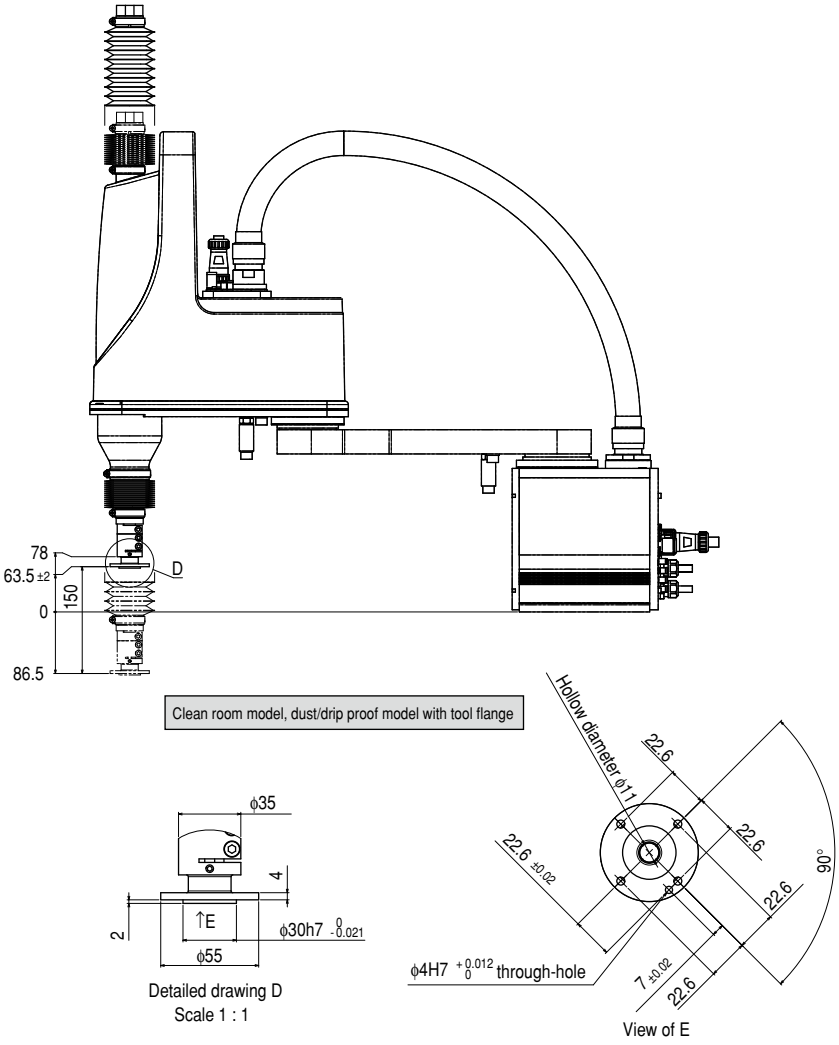




23513-HM-00

YK600XGLC, YK600XGLP

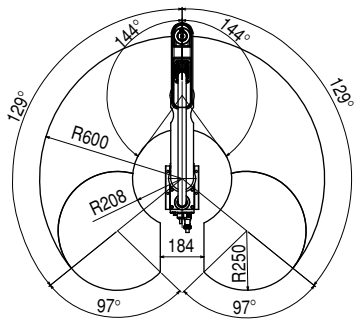
Tool flange mount type



23514-HM-00

YK600XGLC, YK600XGLP

Working envelope



Option :
- X-axis additional stopper: X-axis mechanical stopper position can be changed to 119°-position (working envelope, 117°).
- Y-axis additional stopper: Y-axis mechanical stopper position can be changed to 108°-position (working envelope, 116°).

Other option: Standard coordinate setting jig

- Note that the robot cannot be used at a position where the base flange, robot cable, spline, bellows, and tool flange interfere with each other in the working envelope shown above.
- X-axis mechanical stopper position : 131°
- Y-axis mechanical stopper position : 146°

23515-HM-00

Revision record

Manual version	Issue date	Description
Ver. 1.00	Jul. 2012	First edition

Installation Manual

SCARA Robots

YK-XG Series

Jul. 2012
Ver. 1.00
This manual is based on Ver. 1.00 of Japanese manual.

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Please use the following for more detailed information.
http://www.yamaha-motor.co.jp/global/industrial/robot/

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